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TRANSPORTATION CONTROL STRATEGY DEVELOPMENT FOR NEW YORK METROPOLITAN AREA

Fred Winkler

TRW Transportation and Environmental Operations

Prepared for:

Environmental Protection Agency

December 1972

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Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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Prepared by

TRW Transportation and Environmental Operations
7600 Colshire Drive
McLean, Virginia 22101

Contract No. 68-02-0048

EPA Project Officer: Fred Winkler

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1.0 INTRODUCTION

Air pollution and congestion problems which plague New York and other American Cities are one consequence of the historical development of land use patterns and transportation systems. These two factors have been closely related. Higher density development on Manhattan clearly reflects the accessibility afforded by mass transportation. The dispersed low density housing of the region'surban fringe, which has undergone phenomenal growth since 1945, is automobile oriented. The separation of housing, employment opportunities, commercial, educational and recreational activities has created an absolute reliance upon mechanized transportation.

Due to the relatively high pollution emissions from the internal combustion engine pollution control strategies focus on these mobile as well as fixed sources.

1.1 BACKGROUND

The Federal Clean Air Act of 1970 made provision for the setting of national ambient air quality standards (NAAQS's) for several pollutants, among them the automobile-related ones carbon monoxide (CO), photochemical oxidants (Ox), and oxides of nitrogen (NO_x). Subsequently, in April 1971, such standards were promulgated by the Federal Environmental Protection Agency (EPA). All states and territories of the United States were to submit air quality implementation plans for meeting these standards by July 1, 1975. However, the State of New York requested, and was granted, an extension of the deadline for mobile-source pollutants to July 1, 1977. As a result, New York must submit, by February 15, 1973, a definitive, detailed air quality implementation plan containing suitable transportation control measures for achieving compliance with the subject standards in 1977.

Because the New York City Department of Air Resources (NYCDAR) has a great deal of experience in air pollution control, transportation problems, and other related areas, the New York State Department of Environmental Conservation chose to rely heavily on the city organization for the plan preparation. In addition, because of the time and manpower restrictions involved, EPA contracted with TRW Inc., to provide technical assistance to the state and city in the preparation of the plan. This report documents the extent of this assistance.

2.0 LIMITATIONS OF THE TRANSPORTATION CONTROL STRATEGY ANALYSIS

A basic requirement to be met by any acceptable air pollution control strategy is that emission levels following implementation of the strategy be consistent with the attainment and maintenance of National Ambient Air Quality Standards. Satisfaction of this requirement depends upon a detailed knowledge of current air quality levels and a quantification of the pollutant emissions in the region. Additionally, a practical transportation control strategy must consider the economic factors associated with its adoption and also the social and political changes necessary to accomodate each specific control measure. Thus, the air quality benefits of any action must be balanced against the social and economic dislocations caused by its implementation. Long-term regional transportation goals and policies must be balanced against the need to achieve specific degrees of emission reduction by 1977. Limitations in the data available and in the analytic method used became obvious during the course of this study, and care must be taken in the interpretation and evaluation of the control strategy recommendations contained in this report. Several specific areas in which the present study needs to be confirmed and validated by future study are listed below.

2.1 AIR QUALITY MONITORING

Two basic areas of concern appear in connection with air quality data available for this project. First and most importantly, ambient monitoring at only a few points generally fails to give an adequate appreciation of the regional character of the air pollution problem. It is impossible to determine whether a particular monitor is being adversely affected by local sources which cause unrealistically high readings in terms of the regional problem, or, conversely, whether there are areas of maximum ambient pollution left unmonitored. The only solution to this problem lies in increasing the number and geographical spread of ambient monitors. Data from the extended monitoring network should be used to constantly evaluate and update the control measures presented in this document. The second problem concerning the use of air quality monitoring data lies in the statistical manipulations and projections used to determine the required level of reduction for the attainment of standards. Basing an extensive control program on measurements obtained in one or two hours per year may lead to the imposition of unduly strict control measures. The trend of ambient measurements during the period before the target year of 1977 must be carefully watched and used to adjust control measures according to observed ambient conditions. Further, specific high measurements obviously due to adverse meteorological conditions may be considered as episode control situations and may not require the imposition of long-term transportation controls for their solution.

2.2 EMISSION FACTORS

The mobile source emission estimates developed as part of this study were based upon the best available emission factors. These emission factors were obtained both from EPA(1) and from NYCDAR(2, 3), and are continually being updated as better data become available. It is highly recommended that the new emission factors be utilized as they become available to recompute and redefine the severity of the mobile source generated emissions in the region. Finally, the emission factors used in the study relate speed to the emission only on the basis of the integrated driving cycle. This has prevented the accurate assessment of changes in emissions due to improved traffic flow characteristics in core, center city areas.

2.3 COLD-START EMISSIONS

Preliminary data have shown that the emissions generated during the first few minutes of vehicle operation represent a large and increasing portion of the total emissions during any individual vehicle trip. An implication of this fact is, that to actually reduce mobile source emissions, it may be necessary to effect a reduction in total vehicle trips rather than merely reducing the number of vehicle miles traveled. Unfortunately, the data relating to this phenomenon were not sufficiently developed to be used in the analysis presented in this study. Another implication of high level cold-start emissions for the control strategy might be in the control of large parking facilities as stationary sources. Again, it has not been possible to quantitatively describe the effect of this type measure on the regional air pollution problem in this report.

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(1) D.S. Kircher and D.P. Armstrong, "An Interim Report on Motor Vehicle Emission Estimation" (Draft), Environmental Protection Agency, October 1972.

(2) "Proposed Plan for Meeting Federal Air Quality Standards Relating to Carbon Monoxide, Hydrocarbons, Nitrogen Oxides, and Oxidants in New York City," New York City Department of Air Resources, January 1972.

(3) Personal Communication with Michael P. Walsh, NYCDAR, October 10, 1972.

2.4 TRAFFIC DATA AND PROJECTIONS

Traffic data and traffic projections have not historically been collected with a view to the estimation of motor vehicle air pollution emissions. This fact has necessitated the reworking of traffic data including vehicle flows, speeds, and modal mixes into the format necessary for emission calculations. Certain assumptions and potential inaccuracies have been introduced by this process. Further, the trends and projections in vehicle growth have been prepared by various agencies and often little unanimity has been found concerning appropriate growth rates. These data in certain cases require that a close watch be maintained both on traffic changes and ambient air quality during the period between now and full strategy implementation so that any deviations from the expected vehicle emission rates can be determined and appropriate adjustments made in the control strategy. It should be noted that stationary source emission projections also suffer from inaccuracies in the projection of industrial growth and in the application of as yet untested control technologies to control of these stationary sources.

2.5 ANALYTIC TECHNIQUES USED

The key analytic calculation performed in this study is the relation between emission rates and ambient air quality. Due to the time restraints it was not possible to utilize sophisticated mathematical modeling techniques in the development of this relation between emissions and air quality, and simpler static modeling techniques cannot be used in systems having the complexity of the New York City atmosphere. Hence, control strategy reductions were based on proportional rollback techniques relating existing emissions and air quality on a proportional basis. The use of modeling is highly recommended since it will both include the effects of local meteorological and topographical features and indicate, in a way that rollback estimation cannot, the geographical extent of the regional air pollution problem. Such modeling and simulation exercises using models currently under development should be carried out during the years between now and 1977 and should be used to modify, if required, the control strategy recommended in this document.

2.6 EFFECTS OF CONTROL MEASURES

It was not possible to precisely quantify the emission reduction effect of some of the control measures considered in this document. For example, the effect of inspection and maintenance program depends strongly upon the exact test procedure used, maintenance recommendations, the quality and availability of trained mechanics and a host of other factors which were impossible to define exactly during this study. Similarly, mass transit improvements can be expected to reduce vehicle miles traveled within the region. The extent of this reduction is unknown until specific data concerning the economic elasticity of the various travel demands, the modal split of trips within the region, and many other factors have been carefully evaluated.

It is strongly recommended that programs be instituted to provide additional data and to apply more sophisticated analytic techniques in the areas listed above. Work must begin upon the implementation of the required regional control measures in the immediate future. However, final implementation and enforcement should be dependent upon data collected during calendar years 1973, 1974, and even 1975. Full consideration must be given to the political, jurisdictional, and social impact of all control actions. The control measures presented in this document must be considered as an initial attempt to quantify the relationship between transportation processes and the regional air pollution problem. The further study indicated should be used to modify this baseline effort. The air pollution implications of the transportation process are very complex and a modification of this process can potentially effect significant changes in the social and economic character of the metropolitan region.

3.0 SUMMARY

3.1 AIR QUALITY

At one or more points within the boundaries of New York City, the NAAQS's for CO, O_x, and NO_x are exceeded. The detailed air quality analysis is found in Section 4.0 and Appendix A, but the principal features are:

- CO - The highest levels are observed in the downtown and midtown sections of Manhattan where maximum eight-hour concentrations of 45 ppm (parts-per-million) and 32 ppm, respectively, have been recorded. The maximum eight-hour standard is 9 ppm.
- O_x - The general New York area appears to have maximum one-hour, oxidant levels of about 0.18 ppm, compared with a national standard of 0.08 ppm.
- NO_x - Congested areas have maximum one-hour NO_x levels of about 0.08 ppm, while other areas are approximately half that value. The standard is 0.05 ppm annual average.

It should be noted that photochemical oxidants, unlike CO and NO_x are not emitted directly by motor vehicles. Hydrocarbons (HC), which are emitted by motor vehicles, undergo a complex system of reactions to produce O_x. It is assumed in this report, as has been assumed in most other work of this kind, that atmospheric levels of O_x are proportional to hydrocarbon emission rates. Therefore, O_x levels can be controlled by reducing hydrocarbon emissions.

3.2 EMISSION REDUCTIONS NEEDED

The required emission reductions for transportation-related pollutants are presented in detail in Section 4.0. For the most-critical areas, the estimated percentages by which 1970 emissions must be lowered to meet the national air quality standards are as follows:

- CO - downtown - 80% reduction
  midtown - 72% reduction

- O_x - 56% reduction of HC
- NO_x - 38% reduction in congested areas
  0% reduction elsewhere

3.3 STRATEGY CONSIDERATIONS

3.3.1 Control Measures

A descriptive list of transportation control measures being considered by NYCDAR is presented in Appendix E. However, for the following reasons, it was not possible to make quantitative estimates of the air quality impacts of each measure:

- The relation between the control measures and the resulting emission reductions was undefined in most cases.
- Cost and time considerations prevented detailed analysis of all the measures.

However, four control measures considered to have good potential for emission reduction were studied in detail:

- Vehicle Turnover - replacement of older vehicles, some of which are pre-emission-control, by newer vehicles has a great effect, particularly in Manhattan.
- Retrofit Program for Heavy-Duty Vehicles - because of the large percentage of travel accounted for by this vehicle class in some New York areas, installation of control devices would have great effect.
- Inspection/Maintenance of Taxis - in lower Manhattan, because of the high degree of taxi travel, this program offers good potential.
- Inspection/Maintenance of Personal Vehicles - for NYC as a whole, the personal automobile is the principal emission source, and preventing (or slowing) deterioration of the associated control devices is an effective control measure.

The detailed analysis of the effects of these control measures on air quality is found in Section 5.0. In addition, a recently completed document prepared by TRW for EPA offers additional information on the effectiveness of traffic flow improvements(1).

3.3.2 Data Base

Detailed discussions of the air quality and emissions data base are in Appendix A, while the transportation data base is presented in Appendix B.

3.3.2.1 Air Quality and Emissions Data

These data were taken from the New York City Implementation Plan (Section 1.0, Reference 2) or were obtained directly from NYCDAR personnel. Some emission factors were obtained from EPA (Section 2.0, Reference 1).

3.3.2.2 Transportation Data

These data were obtained from the Tri-State Regional Planning Commission, the New York City Planning Commission and the Port of New York Authority.

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(1) "Prediction of the Effects of Transportation Controls on Air Quality in Major Metropolitan Areas," prepared for Environmental Protection Agency by Transportation and Environmental Operations of TRW Inc., 20 November 1972.

4.0 PROGRAM PURPOSE AND DESCRIPTION

4.1 REGIONAL DESCRIPTION

The Tri-State Regional Planning Commission has been designated by the federal government as the official planning agency for New York, New Jersey, Connecticut Tri-State Region. The Commission is also a central supporting resource for subregional and local planning.

The Commission's reports contain the following facts.

> "The region consists of 28 counties with more than 18 million residents and 8,000 square miles of land area. Almost one-tenth of the nation lives and works within a 60 mile radius of Times Square. Nearly half of the population lives on the central-most five percent of the land. The nation's most dense concentration of housing occurs on Manhattan where at one location 150,000 persons live in a single square mile of land. The region's work places are even more concentrated than its population. Nearly one-third of the labor force travels each weekday to the nine square-mile area south of Central Park in Manhattan. No more than ten percent of these, arriving and departing in the peak hour, can use the type mode of travel to work used elsewhere in the nation -- the automobile. The 4.5 million autos garaged and cared for within the region travel 100 million miles per day."(1)

The computer model used for the New York area made use of a four-hundred square mile grid network shown as Figure 4-1. Although this grid included parts of New Jersey, only those sections of Manhattan, the Bronx, Brooklyn, and Queens shown on the figure were subjected to a detailed analysis. The study area includes the most critical parts of the city from the standpoint of transportation-related pollutant emissions.

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(1) "Tri-State Transportation 1985 an interim plan," Tri-State Transportation Commission, May 1966.

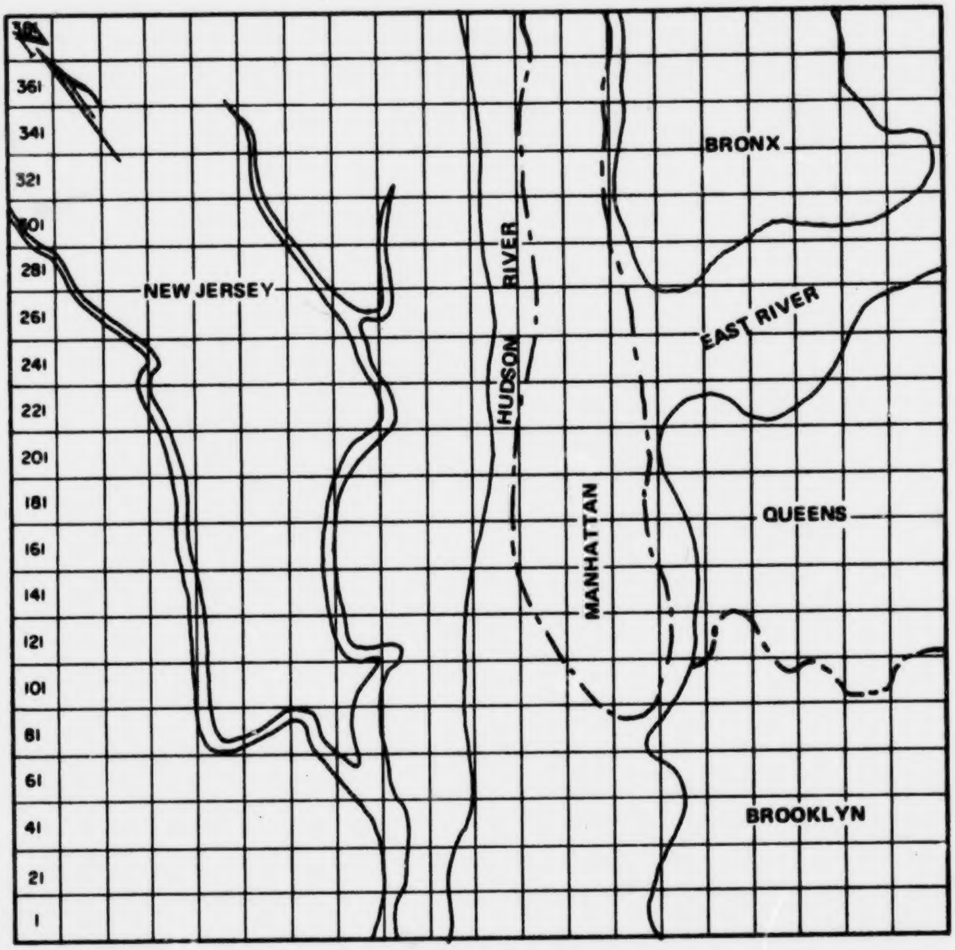
381
361
341
321
301
281
261
241
221
201
181
161
141
121
101
81
61
41
21
1
NEW JERSEY
HUDSON RIVER
MANHATTAN
BRONX
EAST RIVER
QUEENS
BROOKLYN

Figure 4-1 New York City Grid.
(1 square = 1 square mile)

4.2 NEW YORK AIR QUALITY PROBLEMS

New York air quality and the emission reductions required to meet the national ambient air quality standards are summarized in Table 4-1. Again, it should be stated that these data are based on limited analyses at only a few monitoring sites. The sampling network should be considerably expanded so that the improvement in air quality can be monitored during implementation of the control strategy. In this way, changes in the plan can be made if the air quality data indicate a deviation from the current projections.

4.2.1 Air Quality Network

The sampling stations from which the data of Table 4-1 were obtained are:

- CO - downtown Manhattan on Canal Street; midtown on the 59th Street Bridge approach; and East Harlem on 121st Street.
- Ox - only one station, located at the Cooper Union Engineering building above 9th Street in downtown Manhattan.
- NO_x - sampling sites not documented at this time. (Data were obtained by telephone from NYCDAR.)

The sampling network clearly needs expansion, particularly for Ox and NO_x, if the chosen control strategy is to be properly monitored. The following additions could be useful:

- CO - the CBD's of boroughs other than Manhattan are virtually unmonitored at this time. Possibly a mobile unit could be used to determine where other stations are needed.
- Ox - because oxidants do not necessarily form at the areas of maximum hydrocarbon emissions, Ox should be monitored away from the congested areas. A program is currently underway in Nassau County to define the nature of the NYC area Ox problems, if such exist.
- NO_x - oxides of nitrogen can create local problems and also participate in the formation of Ox, an area problem. Monitoring stations are needed in some of the central business districts to find whether local problems are occurring.

TABLE 4-1
AIR QUALITY DATA AND ROLLBACK ESTIMATES*

Pollutant	Sampling Location	1-HOUR MAXIMUM			8-HOUR MAXIMUM		
		Standard	Actual	Rollback %	Standard	Actual	Rollback %
CO	Downtown (Canal St. P.O.)	35	85	59	9	45	80
CO	Midtown (Grand Central Area)	35	65	35	9	32	72
CO	Rest of NYC (East Harlen)	35	21	0	9	9.5	5.6
Ox	General Area	0.08	0.18	56	--	--	--
NO_x	Midtown & Downtown	0.05**	0.08**	38	--	--	--
NO_x	Rest of NYC	0.05**	0.04**	0	--	--	--

*Concentrations are parts per million (vol./vol.).
**Annual Average.

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16. Abstracts

The document demonstrates the nature of the Air Quality problem attributed to motor vehicle operation, the magnitude of the problem and a strategy developed to neutralize these effects in order that National Ambient air quality standard may be attained and maintained.

17. Key Words and Document Analysis. 17a. Descriptors

Motor Vehicle emitted pollutants - air pollutants originating within a motor vehicle and released to the atmosphere.

National Ambient Air Quality Standards - Air Quality Standards promulgated by the Environmental Protection Agency and published as a Federal Regulation in the Federal Register.

17b. Identifiers/Open-Ended Terms

VMT - Vehicle Miles Traveled
Vehicle Mix - distribution ofmotor vehicle population by age group.
LDV - light duty vehicle - less than 6500 lbs.
HDV - heavy duty vehicle - greater than 6500 lbs.

17c. COSATI Field/Group Environmental Quality Control of Motor Vehicle Pollutants.

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4.2.2 Estimated Emission Reductions Needed

Because of the time and money limitations of this study, an air quality model having sufficient sophistication to describe the New York City airshed could not be developed. In lieu of such a model, a simple proportional model was used to describe the relation between air quality and emissions. The details are given in Appendix A. Where pollutant concentrations based on different averaging times yield different rollback (emission reduction) percentages, the more-conservative, numerically larger, reduction should be used. Under this constraint, the needed emission reductions are as follows:

- CO - (based on maximum 8-hour level)
  Downtown - 80%
  Midtown - 72%
  Non-CBD - 5.6%
- HC - (based on maximum 1-hour Ox reading)
  Entire Area - 56%
- NO_x- (based on maximum 1-hour level)
  CBD - 38%
  Non-CBD - 0%

It must be emphasized that the air quality data base is very limited and these rollbacks should be confirmed or disallowed by more extensive monitoring.

4.3 PURPOSE OF STUDY

The present study is intended to provide a technical basis for the development of a comprehensive transportation control strategy to enable the New York City metropolitan area to meet the ambient air quality standards of motor vehicle-related air pollutants by July of 1977. The program is divided into two task areas, control strategy development and control strategy implementation, the individual tasks of which are listed in the remainder of this section.

4.3.1 Control Strategy Development

- Development of Air Quality Data Base
- Development of Transportation Data Base
- Development of Emissions Data Base
- Definition of Control Measures
- Development of Control Measure Impact Data
- Determination of Obstacles to Implementation of Control Measures

4.3.2 Control Strategy Implementation

- Timetable for Implementation
- Agency Involvement
- Legal Authority (State and city preferred to handle this themselves.)
- Surveillance Check Points

5.0 CONTROL STRATEGY DEVELOPMENT

5.1 EMISSION ESTIMATES

5.1.1 Methodology

Motor vehicle emission estimates are basically the products of two numbers: (1) vehicle miles traveled (VMT), and (2) emission factors (emission rates expressed in grams of pollutant per mile traveled). The emission factors are functions of several variables:

- Modal Mix
- Age Distributions of Vehicles
- Vehicle Speeds
- Types of Emission Controls

The detailed computational methods used to develop emission factors in New York are given in Appendix A, but briefly, the steps involved are as follows:

1. The most important modal contributors to total annual VMT for three major areas of New York were determined from transportation data. Tables 5-1, 5-2, and 5-3 show the modal distributions for the areas chosen for analysis.
2. Emission factors were computed for the important motor vehicle modes in each of these areas.
3. An overall emission factor for each analysis area was then developed by multiplying the emission factor for each mode by the fraction of total VMT accounted for by each mode and summing these products. These emission factors, uncorrected for speed, are given in Table 5-4.

VMT data and speed data for each mile square section of the New York grid (Figure 4-1) were determined by procedures discussed in Appendix B. The motor vehicle emissions in each square mile were determined by taking the products of the VMT, the pertinent emission factor, and a speed adjustment factor (Reference 2-1) for each section.

TABLE 5-1

MODAL TRAFFIC DISTRIBUTION IN DOWNTOWN CBD AS PERCENTAGES OF TOTAL VMT*

Year	Auto	Bus (D)	Bus (G)	Taxi (M-F)	Taxi (M-NF)	Taxi (N-M)	Truck (D)	Truck (G)
1970	32.2	3.3	—	14.1	6.5	1.1	7.1	35.7
1975	36.4	3.1	—	15.2	7.0	1.2	6.1	31.1
1977	37.9	3.0	—	15.6	7.2	1.2	5.6	29.4

*Based on data in the New York City Implementation Plan, January 1972.

Abbreviations:

D = Diesel
G = Gasoline
M-F = Fleet Medallion
M-NF = Non-Fleet Medallion
N-M = Non-Medallion

TABLE 5-2

MODAL TRAFFIC DISTRIBUTIONS IN MIDTOWN CBD AS PERCENTAGES OF TOTAL VMT*

Year	Auto	Bus (D)	Bus (G)	Taxi (M-F)	Taxi (M-NF)	Taxi (N-M)	Truck (D)	Truck (G)
1970	18.0	2.4	—	38.1	17.7	2.9	3.5	17.4
1975	19.6	2.1	—	39.5	18.2	3.0	2.9	14.7
1977	20.2	2.1	—	39.9	18.4	3.1	2.6	13.7

Abbreviations:
D = diesel
G = gasoline
M-F = fleet medallion
M-NF = non-fleet medallion
NM = non-medallion

*Based on data from NYC Implementation Plan, January 1972.

TABLE 5-3

MODAL TRAFFIC DISTRIBUTIONS OF BRONX, KINGS AND QUEENS COUNTIES AS PERCENTAGES OF TOTAL VMT*

Year	Auto	Bus (D)	Bus (G)	Taxi (M-F)	Taxi (M-NF)	Taxi (NM)	Truck (D)	Truck (G)
1970	89.4	1.0	0.1	—	—	—	1.6	7.9
1975	91.1	0.9	0.1	—	—	—	1.3	6.6
1977	91.6	0.8	0.1	—	—	—	1.2	6.2

Abbreviations:
D = diesel
G = gasoline
M-F = fleet medallion
M-NF = non-fleet medallion
NM = non-medallion

*Based on data from NYC Implementation, January 1972.

Table 5-4. NEW YORK CITY EMISSION FACTORS* (grams/mile)

Case	DOWNTOWN			MIDTOWN			REST OF NYC		
	CO	HC	NOx	CO	HC	NOx	CO	HC	NOx
1970-Baseline	89.6	17.3	11.9	73.1	12.3	9.44	71.8	12.0	5.06
1975-Uncontrolled	57.8	12.7	9.79	35.5	7.29	6.43	46.3	6.64	4.95
1977-Uncontrolled	44.4	9.81	8.48	25.6	5.36	5.11	31.7	3.63	3.54
1984-Uncontrolled	22.8	7.04	7.05	13.6	3.84	4.09	9.22	2.15	2.21
1977-Measure A	28.2	6.29	8.48	18.1	3.73	5.11	28.3	2.37	3.54
1977-Measure B	44.2	9.78	8.48	25.2	5.29	5.11	31.7	3.63	3.54
1977-Measure C	43.7	9.70	8.48	25.1	5.29	5.11	29.3	3.42	3.54
1977-Measures A,B,C, (Combined)	27.3	6.15	8.48	17.2	3.59	5.11	25.9	2.66	3.54

*Uncorrected for speed. See Appendix A for details.

Abbreviations:
A = control measure A (retrofit and inspection/maintenance of heavy-duty vehicles)
B = control measure B (inspection/maintenance of taxis)
C = control measure C (inspection/maintenance of personal cars)

Stationary source emissions were available only on a county-wide basis, and they were apportioned to the grid areas by using the VMT for each grid as an apportioning factor. Data were available for 1970 and 1977, but the projections for 1984 were based on 1977 data for lack of better information.

5.1.2 Baseline (1970) Emissions

The methodology of the preceding paragraphs was used to determine CO, HC, and NO_x emissions in the New York area for several cases, including 1970 as a baseline case. The results are given in Table 5-5 for the grids showing the maximum emission densities in several critical areas of New York. These "worst" grids are in the following locations:

- Grid (75) - this grid includes the intersection of the Prospect and the Brooklyn-Queens Expressways, in Brooklyn.
- Grid (134) - this grid includes the eastern part of the downtown Manhattan central business district (CBD).
- Grid (193) - this area lies around Rockefeller Center in midtown Manhattan.
- Grid (195) - the Long Island Expressway approach to the Queens-Midtown Tunnel passes through this grid in west Queens.
- Grid (315) - this grid contains the intersection of the Cross Bronx Expressway and the Grand Concourse in the Bronx.

For the primary pollutants, CO and NO_x, these grids are of primary importance since these gaseous emissions can create highly-localized air quality problems at the sites of maximum emission density. However, photochemical oxidants require a few hours for their formation from hydrocarbons and NO_x, so that an area-wide problem normally results. In this case, it is considered preferable to analyze the problem in terms of area emissions, such as the data of Table 5-6. A better look at area-wide emissions is provided by study of the emission density grid maps, Figures 5-1 through 5-8.

Table 5-5. AIR POLLUTANT EMISSION ESTIMATES FOR THE "WORST" SQUARE MILES IN DIFFERENT AREAS OF NEW YORK CITY (tons/year)

Case	Downtown (134)			Midtown (193)			Bronx (315)			Brooklyn (75)			Queens (195)		
	CO	HC	NO_x	CO	HC	NO_x	CO	HC	NO_x	CO	HC	NO_x	CO	HC	NO_x
1970-U	20,730	4,870	9,019	9,751	2,053	4,381	5,667	1,149	1,381	8,462	2,813	2,533	10,915	2,700	3,431
1975-U	13,998	3,765	5,267	4,452	1,228	2,297	3,679	643	1,372	5,825	2,111	2,537	7,412	1,761	3,438
1977-U	10,804	3,029	4,962	3,236	981	2,142	2,614	436	1,271	4,159	1,791	2,392	5,218	1,334	3,234
1984-U	6,123	2,483	4,729	1,910	828	2,051	964	332	1,184	1,569	1,630	2,267	1,813	1,121	3,055
1977-A	6,931	2,149	4,962	2,317	773	2,142	2,355	376	1,271	3,752	1,698	2,392	4,682	1,210	3,234
1977-B	10,755	3,020	4,962	3,188	972	2,142	2,614	436	1,271	4,159	1,791	2,392	5,218	1,334	3,234
1977-C	10,638	3,003	4,962	3,174	972	2,142	2,430	418	1,271	3,871	1,765	2,392	4,840	1,300	3,234
1977-All	6,716	2,114	4,962	2,207	755	2,142	2,171	358	1,271	3,464	1,672	2,392	4,304	1,176	3,234
Allowable	4,146	NA	5,592	2,730	NA	2,716	5,350	NA	MS	7,988	NA	MS	10,304	NA	MS

Abbreviations:
U = uncontrolled (vehicle turnover alone).
A = control measure A (retrofit and inspection/maintenance of heavy-duty vehicles).
B = control measure B (inspection/maintenance of taxis).
C = control measure C (inspection/maintenance of personal cars).
All = all of the control measures.
NA = not applicable, HC is treated on an area-wide basis (see Table 5-6).
MS = currently meets standards.

Table 5-6. MOBILE SOURCE, STATIONARY SOURCE, AND TOTAL EMISSIONS OF AIR POLLUTANTS IN THE NEW YORK CITY AREA (tons/year)

Case	Carbon Monoxide			Hydrocarbons			Nitrogen Oxides		
	Mobile	Stationary	Total	Mobile	Stationary	Total	Mobile	Stationary	Total
1970-U	1,175,864	97,445	1,273,309	217,875	98,278	316,153	93,216	239,399	332,615
1975-U	788,981	90,491	879,472	123,010	95,336	218,346	91,254	201,187	292,441
1977-U	554,697	90,491	645,188	76,530	95,336	171,866	68,223	201,187	269,410
1984-U	198,609	90,491	289,100	51,932	95,336	147,268	48,766	201,187	249,952
1977-A	473,461	90,491	563,952	57,721	95,336	153,057	68,223	201,187	269,410
1977-B	553,947	90,491	644,438	76,391	95,336	171,727	68,223	201,187	269,410
1977-C	517,943	90,491	608,434	73,065	95,336	168,401	68,223	201,187	269,410
1977-All	435,957	90,491	526,448	54,117	95,336	149,453	68,223	201,187	201,187
Allowable	NA	NA	NA	54,117	84,990	139,107	NA	NA	NA

Abbreviations:
U = uncontrolled (vehicle turnover alone).
A = control measure A (retrofit and inspection/maintenance of heavy-duty vehicles).
B = control measure B (inspection/maintenance of taxis).
C = control measure C (inspection/maintenance of personal cars).
All = all of the control measures.
NA = not applicable, CO and NO_x are treated as local problems (see Table 5-5).

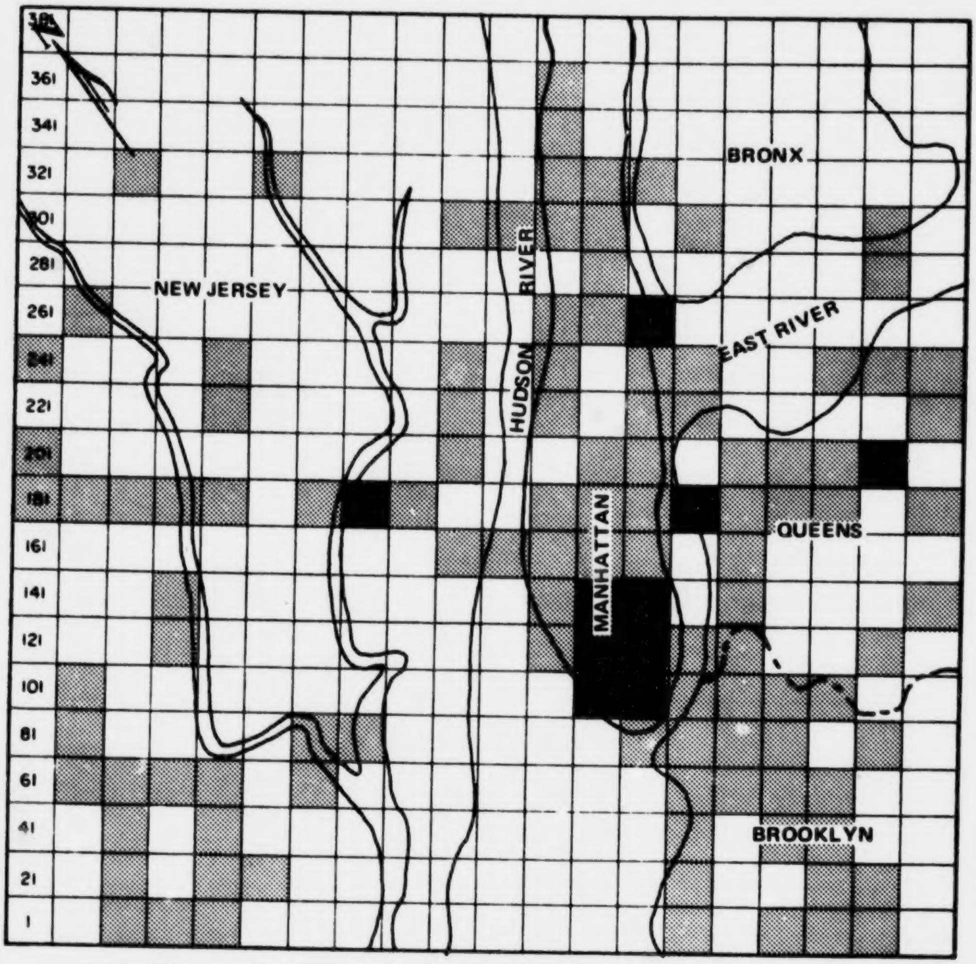
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Figure 5-1. CARBON MONOXIDE EMISSION DENSITIES IN NYC IN 1970
(1 square = 1 square mile)

LEGEND
DARK = >10000 tons/year
MEDIUM = 4001 - 10000 tons/year
WHITE = 0 - 4000 tons/year

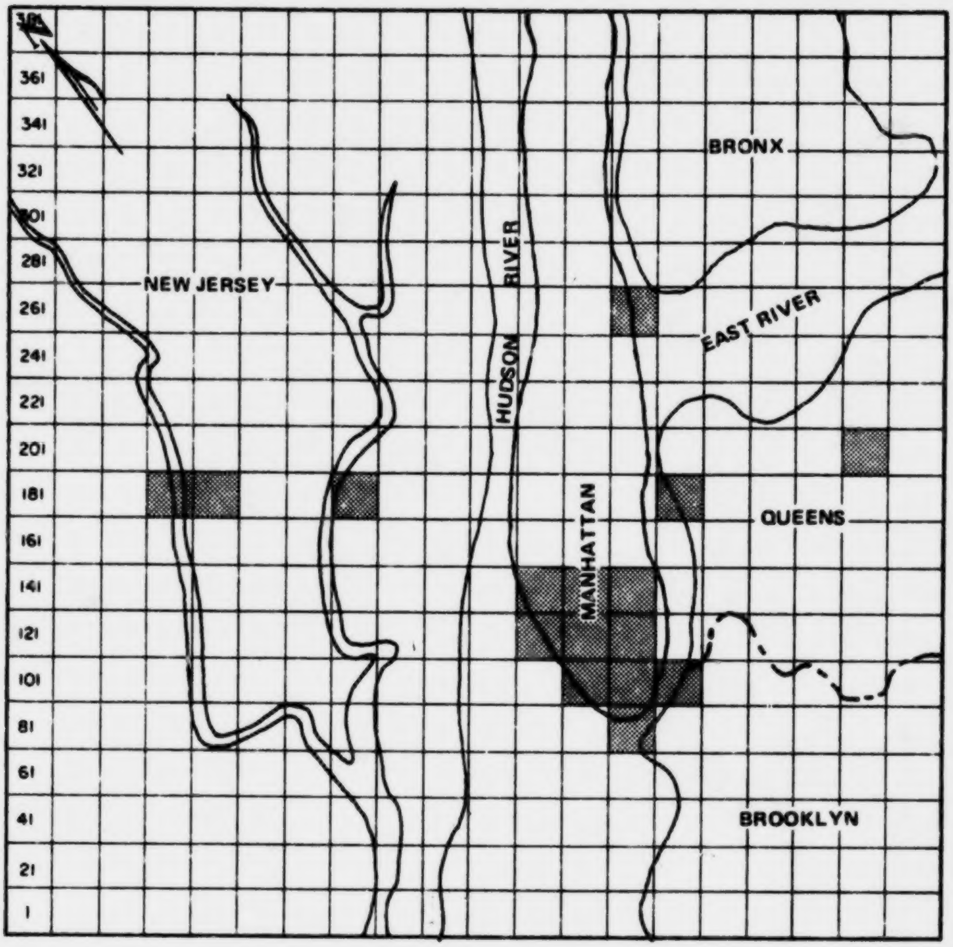
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Figure 5-2. CARBON MONOXIDE EMISSION DENSITIES IN NYC
IN 1977 ASSUMING ONLY FEDERAL EMISSION CONTROLS
(1 square - 1 square mile)

LEGEND
- WHITE = 0 - 4000 tons/year
- MEDIUM = 4001 - 10000 tons/year
- DARK = >10000 tons/year

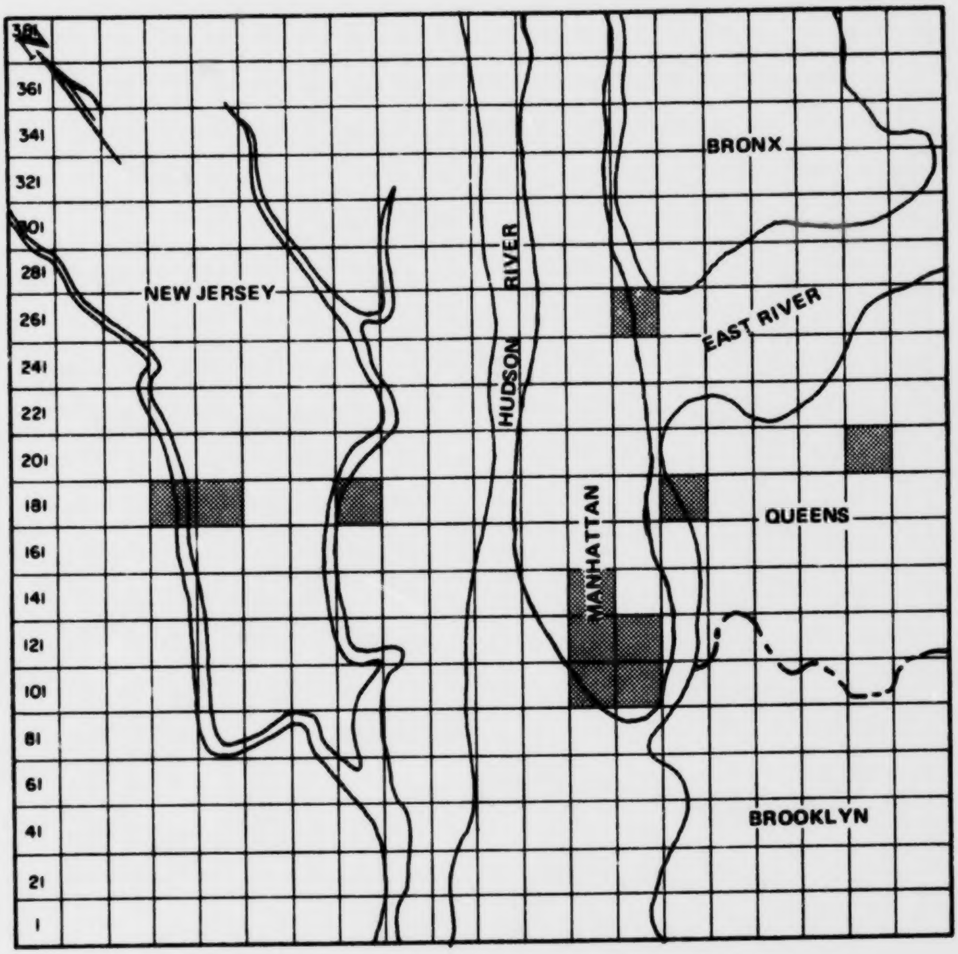
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Figure 5-3. CARBON MONOXIDE EMISSION DENSITIES IN NYC IN 1977 ASSUMING FEDERAL EMISSION CONTROLS AND FULL SET OF HARDWARE CONTROL MEASURES (1 square = 1 square mile)

LEGEND
WHITE = 0 - 4000 tons/year
MEDIUM = 4001 - 10000 tons/year
DARK = >10000 tons/year

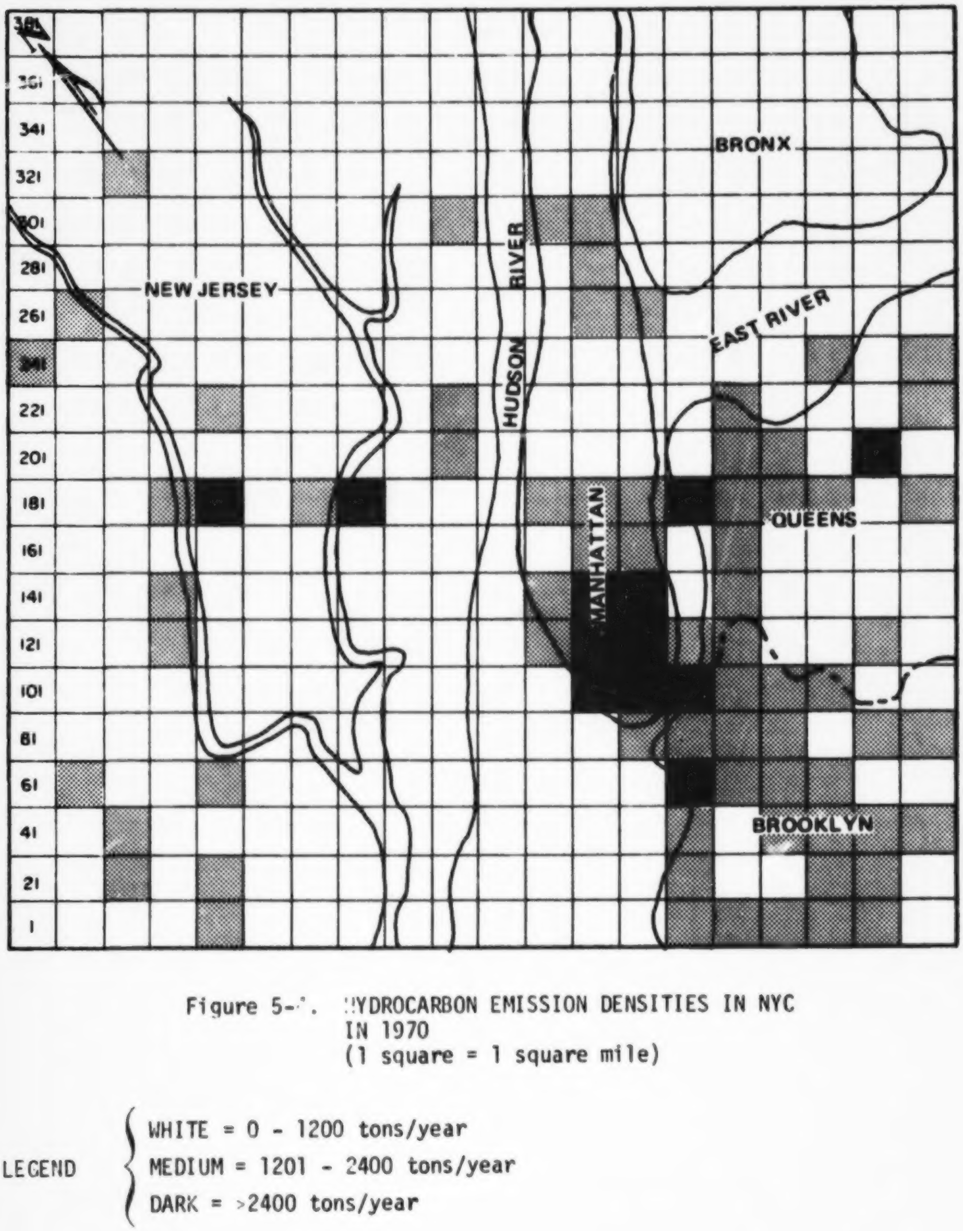
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Figure 5-[illegible]. HYDROCARBON EMISSION DENSITIES IN NYC
IN 1970
(1 square = 1 square mile)

LEGEND
WHITE = 0 - 1200 tons/year
MEDIUM = 1201 - 2400 tons/year
DARK = >2400 tons/year

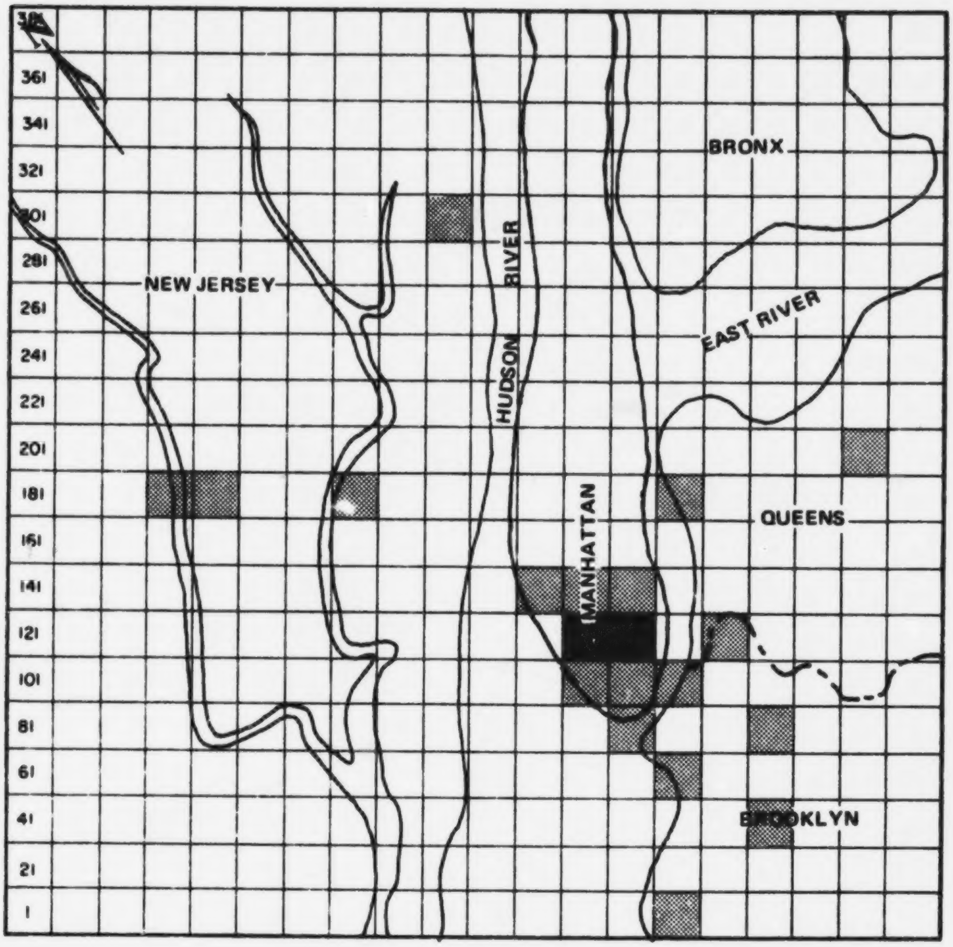
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Figure 5-5. HYDROCARBON EMISSION DENSITIES IN NYC IN 1977 ASSUMING ONLY FEDERAL EMISSION CONTROLS

(1 square = 1 square mile)

LEGEND
WHITE = 0 - 1200 tons/year
MEDIUM = 1201 - 2400 tons/year
DARK = >2400 tons/year

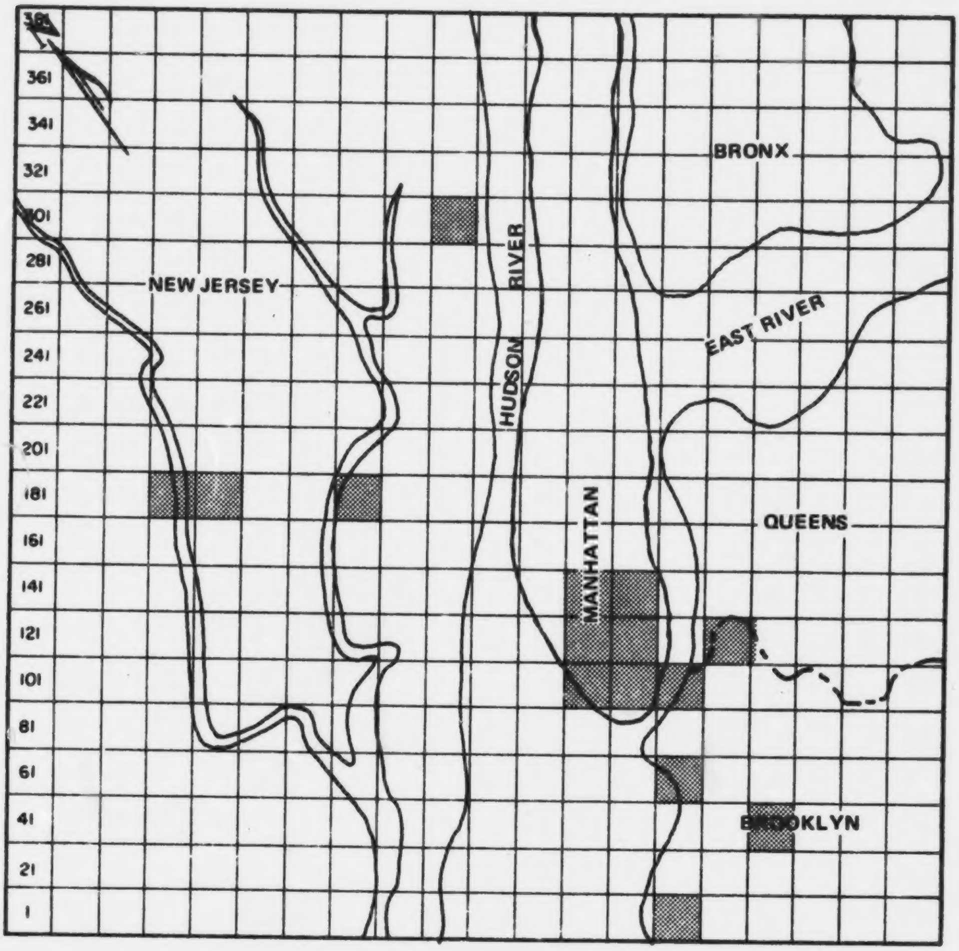
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Figure 5-6. HYDROCARBON EMISSION DENSITIES IN NYC IN 1977 ASSUMING FEDERAL EMISSION CONTROLS AND FULL SET OF HARDWARE CONTROL MEASURES

(1 square = 1 square mile)

LEGEND
- WHITE = 0 - 1200 tons/year
- MEDIUM = 1201 - 2400 tons/year
- DARK = >2400 tons/year

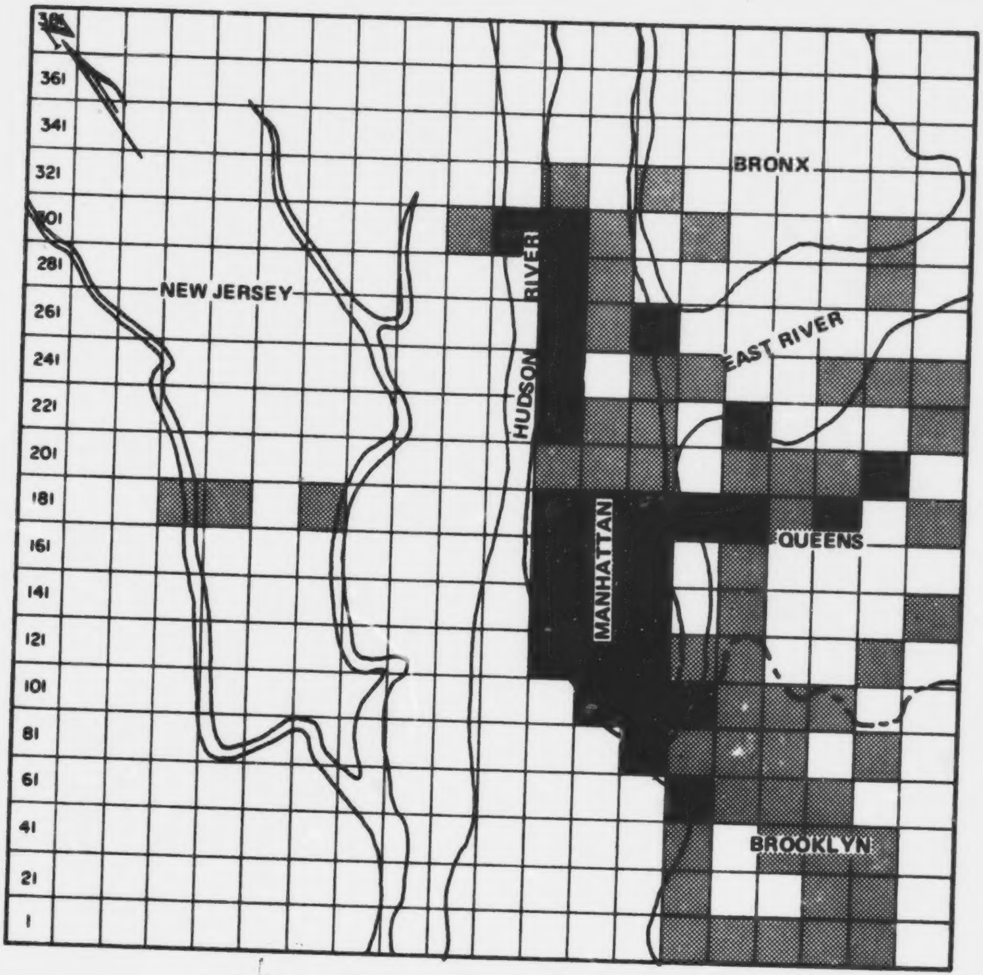
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Figure 5-7. OXIDES OF NITROGEN EMISSION DENSITIES IN NYC in 1970

(1 square = 1 square mile)

LEGEND
- WHITE = 0 - 1200 tons/year
- MEDIUM = 1201 - 2400 tons/year
- DARK = >2400 tons/year

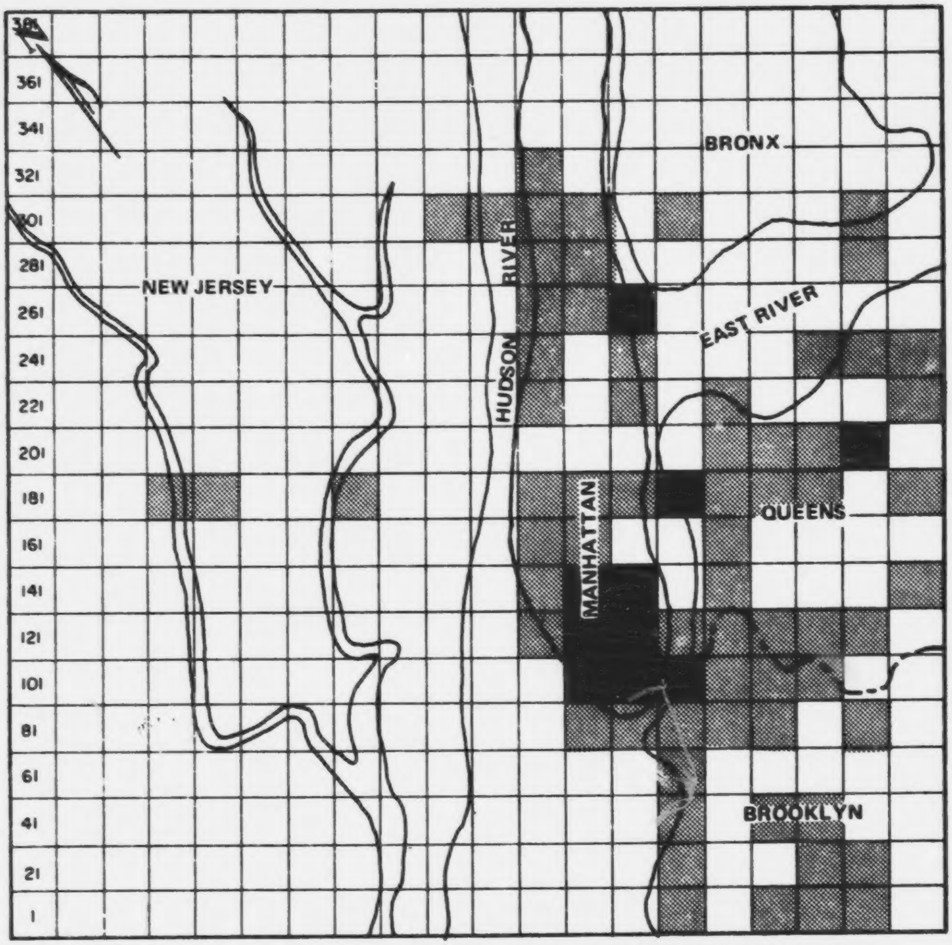
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Figure 5-8. OXIDES OF NITROGEN EMISSION DENSITIES IN NYC in 1977 ASSUMING FEDERAL EMISSION CONTROLS

(1 square = 1 square mile)

LEGEND
- WHITE = 0 - 1200 tons/year
- MEDIUM = 1201 - 2400 tons/year
- DARK = >2400 tons/year

NOTE: None of the hardware control measures are assumed to affect oxides of nitrogen emissions

5.1.3 Future (1975, 1977, 1984) Emissions

Using transportation projections found in Reference 2 of Section 2.0, Tri-State Regional Planning Commission VMT projections, and emission factors based on References 1 and 2 of Section 2.0, emission projections for 1975, 1977, and 1984 were made assuming only vehicle turnover as a control measure. These data are found in Tables 5-5 and 5-6, labeled 1975-U, 1977-U, and 1984-U. The latter table is of particular interest, because it documents the increasing importance of stationary sources in later years, especially stationary sources of HC, and NO_x. The use of transportation controls other than vehicle turnover solely to control oxidants and/or NO_x would be questionable policy.

Estimated emission reduction percentages for these later years, using 1970 emissions as a baseline, are tabulated in Tables 5-7, 5-8, and 5-9 for the grids of maximum emission density. The data indicate the following:

- CO - vehicle turnover will have a large impact within the next seven years, and most areas of New York City could meet the standards in 1977, the major exception being the downtown CBD, where the primary emission source (trucks) is relatively uncontrolled.
- HC - vehicle turnover and relatively minor stationary source controls will reduce New York area emissions by about 46 percent by 1977 compared with an estimated reduction requirement of 56 percent so further controls are indicated.
- NO_x - vehicle turnover coupled with some planned reductions by stationary sources should enable all parts of the city to meet the standard by 1977.

5.2 SUMMARY OF CONTROL MEASURES

5.2.1 Selection of Control Measures

The choice of transportation control measures for New York was based principally upon a study of the modal split data of Tables 5-1, 5-2, and 5-3, together with a knowledge of the emission factors of the modal components (References 1 and 2, Section 2.0). Additional information on the citizen acceptability of transportation control measures was obtained from the results of a survey of New York City area residents summarized in Appendix D. The measures considered and the reasons for their being studied follow:

Table 5-7. ESTIMATED PERCENTAGE EMISSION REDUCTIONS FOR CARBON MONOXIDE IN THE "HOT SPOTS" OF NEW YORK CITY

Area (Grid)	Reduction Needed	1975-Vehicle Turnover Alone	1977-Vehicle Turnover Alone	1984-Vehicle Turnover Alone	1977-Control Measure A	1977-Control Measure B	1977-Control Measure C	1977-All Control Measures
Downtown(134)	80	32	48	70	67	48	49	68
Midtown(193)	72	54	67	80	76	67	67	77
Bronx (315)	5.6	35	54	83	58	54	57	62
Brooklyn(75)	5.6	31	51	81	56	51	54	59
Queens (195)	5.6	32	52	83	57	52	56	60

Table 5-8. ESTIMATED PERCENTAGE EMISSION REDUCTIONS FOR HYDROCARBONS IN THE "HOT SPOTS" OF NEW YORK CITY

Area(Grid)	Reduction Needed*	1975-Vehicle Turnover Alone	1977-Vehicle Turnover Alone	1984-Vehicle Turnover Alone	1977-Control Measure A	1977-Control Measure B	1977-Control Measure C	1977-All Control Measures
Downtown(134)	56	23	37	44	56	38	38	57
Midtown(193)	56	40	52	57	62	53	53	63
Bronx (315)	56	44	62	71	67	62	64	69
Brooklyn(75)	56	25	36	42	40	36	37	40
Queens (195)	56	35	51	58	55	51	52	56

*Based on photochemical oxidant level.

NOTE: As stated in the text Ox/HC is considered as a regional or area problem and this table is intended only as an indication of those boroughs for which further HC emissions reduction controls would be most effective.

Table 5-9. ESTIMATED PERCENTAGE EMISSION REDUCTIONS FOR OXIDES OF NITROGEN IN THE "HOT SPOTS" OF NEW YORK CITY

Area (Grid)	Reduction Needed	1975-Vehicle Turnover Alone	1977-Vehicle Turnover Alone	1984-Vehicle Turnover Alone	1977-Control Measure A	1977-Control Measure B	1977-Control Measure C	1977-All Control Measures
Downtown(134)	38	42	45	48	45	45	45	45
Midtown (193)	38	48	51	53	51	51	51	51
Bronx (315)	0	1	8	14	8	8	8	8
Brooklyn(75)	0	0	6	11	6	6	6	6
Queens (195)	0	0	6	11	6	6	6	6

- Retrofit of Heavy-Duty Vehicles - because this vehicle class, particularly trucks, is relatively uncontrolled and constitutes a large fraction of lower Manhattan traffic, a retrofit program can be used to advantage.

- Inspection/Maintenance of Taxis - although taxis have very high replacement rates (few are more than three years old) and are kept in relatively good states of tune, they account for such a high percentage of total VMT in such areas as the midtown CBD that an inspection program can have significant impact.

- Inspection/Maintenance of Private Automobiles - in the New York area as a whole, the private automobile is the principal motor vehicle emission source and cannot be ignored. In addition, the survey (Appendix D) indicates that New York City residents are in favor of an inspection/maintenance program for air quality improvement.

- VMT Reductions - some of the grids showing extremely high emission densities (such as 134-downtown and 193-midtown) could profit by reduced traffic volume and the better traffic flow which results. This requires further study.

- Flow Improvements - although not included as a specific control measure, flow improvements resulting from on-going highway construction coupled with vehicle restraints should help to reduce emissions.

- Stationary Source Reductions - this measure consists chiefly of rigid enforcement of existing regulations for HC emissions.

5.2.2 Impacts of Control Measures on Transportation

The retrofit and inspection programs will have economic effects on private vehicle, taxi, and truck operators, but should have little effect on the modal patterns. Some older vehicles will probably be taken out of service earlier than would otherwise be the case. Economically, the trucking industry will bear the greatest cost.

A VMT reduction control measure will cause modal shifts, the nature of which depend on which motor vehicle classes are most highly controlled. For lower Manhattan, the private automobile is a possible candidate for reductions. Such measures as the banning of private autos from congested areas would have a direct effect by reducing total VMT and an indirect effect by causing flow improvements in the remaining traffic. Private vehicle VMT reduction would shift traffic to other modes such as taxis or, preferably, to mass transit facilities. A measure this drastic has far-reaching consequences and should be studied in depth before any plans for implementation are seriously considered.

5.2.3 Emission Reduction Potential

The emission reduction potentials of the control measures are detailed in Section 5.3, but are briefly summarized below:

Control Measure	Reduction Potential	
	Lower Manhattan	Rest of NYC
Retrofit Program	Excellent	Good
Taxi Inspection	Good	Poor
Auto Inspection	Fair	Good
VMT Reduction	Good	Fair
Vehicle Turnover	Excellent	Excellent
Flow Improvement	Good	Fair
Stationary Sources	Poor	Good

5.3 PROPOSED CONTROL STRATEGY

The control strategy developed for use in New York City is presented in the following paragraphs. In some cases, such as the hardware-based control measures, the emission reduction potentials could be quantified. However, for others such as very localized traffic flow improvements, a lack of detailed traffic data prevented a quantitative assessment of the actual emission control potential. The latter class of control is used only in downtown Manhattan where some additional reduction in CO emissions (beyond that obtained by vehicle turnover and the hardware measures) is needed to reach the standard. It should also be noted that in estimating the emission reductions of CO and HC required to meet the respective CO and Ox federal standards, the highest measured ambient levels of CO and Ox were utilized for the rollback calculations. This is more stringent than the Federal EPA requirements, which allow the use of the second highest measured values.

5.3.1 Control Measure Definition

The expected vehicle emission reduction percentages for the "hardware" control measures, i.e. retrofit and inspection programs, are tabulated in Table 5-10. The specific control packages are described below:

- Retrofit Package - this will consist of engine modifications (retarded spark, etc.) and a catalytic converter. NO_x controls might be incorporated but these were not included in emission calculations. A twice yearly inspection will be used to insure compliance.
- Inspection/Maintenance - a loaded emission test will be made on taxis three times per year and on private automobiles once annually.

It appears that only the area of downtown Manhattan around the Canal Street Post Office might require VMT reductions. However, the biggest emission source in this area (trucks, even after being retrofitted) is not considered suitable for VMT reduction, because of the potential economic harm which might result. Possible methods for obtaining the estimated additional emission reduction after application of the hardware control measures include the following:

TABLE 5-10

ASSUMED VEHICLE EMISSION REDUCTIONS FOR HARDWARE CONTROL MEASURES

Control Measure	Emission Reduction		
	CO	HC	NO_x
A - Retrofit of Heavy-Duty, Gasoline-Powered Vehicles	50	50	0
B - Inspection/Maintenance of Taxis	10	12	0
C - Inspection/Maintenance of Private Cars	10	12	0

- Uniform VMT Reduction - If VMT of all modes were reduced uniformly, a reduction in vehicular traffic of about 39 percent would be necessary to obtain the incremental reduction. It should be noted that reduction of automobile traffic alone by 100 percent would not accomplish this task.

- Truck Restrictions Alone - Truck and other heavy-duty gasoline-powered vehicle VMT would need to be reduced almost 56 percent. This would require drastic changes in goods-handling procedures, which probably could not be implemented by 1977.

- Pragmatic Flow Improvement/VMT Reduction Approach - The high CO levels recorded at the Canal Street sampling station are due in large part to the terrible congestion problems on this artery. For this reason, the downtown CBD is quite affected by general traffic flow improvements such as the ongoing TOPICS program and the new westside highway construction. These programs should be augmented by strict enforcement of parking regulations and the anti-cruising ordinance for taxis.

At this time, because of the limited data available for this report and the local nature of the problem in downtown Manhattan, the last approach offers the most promise for successful implementation. The other alternatives are quite drastic and would more than likely arouse heated opposition from the affected parties. The questionnaire survey (Appendix D) supports these contentions and suggests that New Yorkers are strongly in favor of even rather drastic flow improvement measures (Question 7) but tend to oppose the stringent restrictions needed for substantial VMT reductions (Question 4a). For these reasons, the extreme VMT reduction control measures should be considered only as contingency solutions.

5.3.2 Air Quality Impacts of Control Measures

The techniques described in the initial sections of this report were utilized to estimate emissions and the emission reduction percentages (1970 baseline) obtained by application of four hardware control measures by 1977:

- Vehicle Turnover
- Heavy-Duty Vehicle Retrofit and Inspection
- Taxi Inspection/Maintenance
- Private Automobile Inspection/Maintenance

The results are tabulated with the previous estimates in Tables 5-5 and 5-6 for emissions and Tables 5-7, 5-8, and 5-9 for reduction percentages. The conclusions drawn from these results are in the following paragraphs.

5.3.2.1 CO Emission Controls

Apparently, the hardware control measures alone could enable all areas of New York City, except for part of the downtown Manhattan CBD, to meet the ambient air quality standard for carbon monoxide in 1977. Because of the conservative rollback estimates used for this analysis, there is a good chance that even this area will meet the standards with no additional controls. Furthermore, TOPICS improvements will improve traffic flow and help reduce CO emissions on a short-term basis. The additional help from strict enforcement of existing parking regulations and reduced taxi cruising will give more assurance of meeting the standard.

5.3.2.2 HC Emission Controls

The very preliminary Ox air quality data available for New York indicate that a 56 percent reduction in hydrocarbon emissions from 1970 levels is needed area-wide to meet the Ox air quality standard. The emission estimates for 1977, with the hardware controls in effect, show a projected emission reduction of 53 percent. Within the accuracy of the air quality, emission factor and traffic data sets, there is no significant statistical difference between these numbers. Nevertheless, because the projections indicate that stationary sources will be responsible for almost two-thirds of the 1977 hydrocarbon emissions (assuming implementation of the hardware control measures) and most of these sources fail to meet existing NYC standards, the transportation controls should be augmented by rigid enforcement of the existing hydrocarbon emission regulations.

5.3.2.3 NO_x Emission Controls

Like the Ox data, air quality data for NO_x are quite limited. The emission projections for 1977 imply that vehicle turnover will enable New York to meet the NO_x air quality standards with no further reductions needed. Nevertheless, the situation should be analyzed more thoroughly during implementation of the plan to insure that the standard will be met.

5.3.3 Social and Economic Impacts

Literally hundreds of potential measures to reduce mobile source emissions have been identified. The New York City Department of Air Resources is considering 31 measures in various combinations. See Appendix E. For each strategy the Department has noted their preliminary evaluation of: Time to Implement; Institutional Feasibility; Implementing Agent; Legal Authority; Action Required and Enforcement. At this time the City and State have committed themselves to three primary strategies. The majority of the required emissions reduction would occur as a result of these strategies. However, additional reduction would be necessary to achieve Federal standards by 1977. Though they would account for only a small percentage of the total reduction, they would create the greatest social and economic impact. They would also be the most difficult to quantify in terms of cost, benefits and impact upon regional air quality. These strategies which are needed to accomplish the smallest incremental air quality benefits often involve high costs, severe impacts and necessitate the greatest degree of cooperation and coordination among public agencies, private groups and the general public.

The following is a brief commentary on the social and economic implications of each of six strategy packages as outlined by the New York City Department of Air Resources. The survey results contained in Appendix D indicates that the public is very sensitive to economic measures and that they prefer bus and car pool express lanes and prohibition of parking and traffic in the central business districts. The most unacceptable measures would be gas rationing, high registration fees and freeway ramp tolls.

The core of the Implementation Plan would be the vehicle controls of Strategy Package A. Both the City and the State have made cost estimates for these measures and the Consultant has estimated the reduction potential of each. For other strategies the key question is --

Who pays in time, money and effort for the implementation of air pollution Strategies? Each creates an impact to the degree to which it changes the daily life style of individuals and in proportion to the number of people affected.

Dollar costs are only one component of the cost equation. Social and environmental costs are also involved. Considering only dollar costs, however, the following types of expenditures should be more thoroughly developed for each strategy:

- Research studies
- Continuous monitoring
- Preparation of plans and programs
- Capital costs for equipment, buildings, land, etc.
- Manpower
- Maintenance
- Operations
- Enforcement

The cost of implementing many programs could be greatly increased due to litigation or the sluggishness of funding agencies. When construction delays result, the cost may increase as much as one-half to one percent per month.

5.3.3.1 Strategy Package A

Reducing emissions at the source involves a multi-faceted program affecting both old and new vehicles. Federal motor vehicle emission controls and changes in vehicle engine design will reduce emissions from new vehicles. Vehicle manufacturers are the responsible agent, and they pass along the cost of this effort to the car buyer. Vehicle inspection/maintenance can significantly reduce emissions by ensuring all in-use motor vehicles are in proper working order, particularly their emission control devices. The required programs are administered by the state. The operating costs are passed directly to the user but start-up costs may be subsidized by state or Federal agencies utilizing tax revenues. Retrofit programs can reduce emissions from in-use pre-1975 vehicles by installation of emission control devices. In this case, the state generally assumes the responsibility for the administration of the necessary programs. The costs are passed on directly to the user or may be subsidized by state agencies utilizing tax revenues.

An inspection and maintenance program for taxi cabs, which account for a high percent of the total VMT in Manhattan, is a necessary element of the implementation plan. Cost of the program would eventually be passed on to the users. The livery industry, representing both unions and management, provides an organized structure through which to work and costs are directly related to the source of pollution and the users who benefit from the taxi service.

5.3.3.2 Strategy Package B

Strategy package B control measures would reduce VMT by disincentives for parking, auto use and auto ownership within high pollution areas. It would also attempt to improve traffic flow which would increase speed and decrease pollution.

The impact of many of the control strategies cannot be assessed by themselves in quantitative terms. In many instances, they constitute segments of multi-faceted comprehensive programs which can contribute to reductions in vehicle travel.

Each strategy which restricts movement in an area, during a certain period of time, or of a particular type of vehicle, will represent a cost factor which must be borne by those who change their established pattern of operation. This emphasizes the importance of understanding the nature of transportation shifts which will result from each strategy. Though it is sometimes overemphasized, accessibility is an important factor in establishing individual opportunity and economic values. Alternatives could then be provided to meet the transportation needs resulting from the changes.

Once critical zones have been established (and this alone will require more accurate and reliable documentation), the nature of vehicle trips and a specific trip ends must be determined in order to effectively structure a course of action which will reduce the VMT. To establish "reasonable" constraints and to provide realistic transit options to serve the important exchange of goods, services and ideas within the critical zones while achieving the desired reductions, the following information would be required:

> For each vehicle type (taxis, light duty trucks, heavy duty trucks, buses, mass transit, private automobile) the number of riders by time of day, number of cold starts, the critical hours, the age of the vehicles, and the origin and destination of trips. For the private automobile, a distinction between those utilized by doctors, diplomats, or other fleet operations such as the police department. Information relative to whether private automobile trips are made by first, second or third cars and the average trip length, speed and duration of stay within the critical area.

The use of police power to enforce control strategies will be a major cost. There are also institutional problems of bringing about an effective enforcement program. For instance, the City of New York has recently established a policy of enforcing the law which prohibits blocking an intersection. Very often the law if not enforced. The enforcement of parking restrictions is complicated by the immunity of M.D. and diplomatic cars.

Enforcement requires the addition of more manpower or the reallocation of manpower priorities. Both involve a policy commitment by city or state officials. Many of the enforcement requirements would necessitate the purchase of new vehicles for surveillance, towing, etc. The towing of a violator's car could involve an administrative cost to the city and possibly for operation of a towing service and the storage of impounded vehicles. In some cities, vehicles are ticketed and locked in place, making the vehicle immobile until such time as a tow truck arrives. Enforcement also creates cost to set up, operate, and staff the necessary courtroom facilities.

The city's zoning regulations and parking policies have an impact on new construction, trip generation and consequently, emissions. Where parking is provided at the edge of congested zones or at suburban park and ride facilities there are costs of acquiring land, grading, paving, lighting, fencing, landscaping, security, snow removal, maintenance and operation. A rule of thumb for the cost of constructing at grade parking space would be six to eight hundred dollars and twenty-five to thirty-five hundred dollars per space for parking structures, exclusive of land. A critical cost factor will be land acquisition. Where persons or businesses are displaced due to property acquisition or hardships resulting from the implementation of control strategies, costs will be incurred. Where Federal funds are involved, all such relocation activities would be subject to the benefits of the Uniform Relocation Act.

Vehicle-free zones are often the most complicated vehicle restrictive measures. The complexity of impact evaluation increases almost exponentially with the size of the area and intensity of use. Each of the factors previously recommended for study in critical zones would constitute a starting point for the evaluation of an auto-free zone. Such measures could also result in land use conversions beyond the target area in response to changes in established transportation patterns and accessibility.

Other more severe strategies restricting use of the private automobile could be recommended. These could be costly and subject to attack if considered on the basis of the travel forecasts and air monitoring data made available for use in this study. It is the consultant's opinion that costly and controversial strategies which would have a major impact on the economic and social character of the region should not be recommended. They would not be defensible until a more comprehensive network of continuous monitoring stations can be established to first determine the actual impact of more acceptable strategies.

Measures to achieve improved traffic flow fall into two categories: construction of new major facilities and operational improvements on existing facilities. Major facilities additions (construction of new freeways, tollways, expressways and major arterial linkages) normally result in sharp increases in travel speed of vehicle trips in the affected corridors. This increase in travel speed can mean a significant reduction in pollutants. However, because these new or improved facilities produce major changes in accessibility they tend to activate latent travel demand, with a resulting increase in vehicle miles traveled. This would eventually cancel the emission reduction gains.

Because of the lead time involved in implementing such facilities, only those projects currently under construction or in the late stages of design and planning need be considered for impact on the 1975-77 air quality levels. Because latent travel activation is largely an incremental long-term effect, it can be ignored for the short-term air quality planning. Operational flow improvements on existing facilities are the object of numerous continuing programs undertaken and funded through Federal, state and local jurisdiction and are typified by the TOPICS program (Traffic Operations Program to Increase Capacity and Safety), a Federal - state - local cooperative venture. Traffic flow improvements on existing facilities entail only marginal changes in travel speed and accessibility, and usually do not introduce the complicating factor of latent travel demand activation. They would be more reasonably justified on the basis of increased safety and efficiency of movement rather than on reductions in air pollution. Within the context of existing information it is not possible to accurately determine the distributional effects of improving traffic flow efficiency in one location upon air pollution control for the entire region. Lubricating the traffic distribution system in one location, it may create bottlenecks or slowups elsewhere. This would result in a degradation of the air quality at locations beyond the "hot spots" receiving attention at the location of the primary improvement. The impact of operation improvements tends to decay over time as a result of normal traffic growth.

Work hour staggering is already widespread enough to produce an extended peak congestion period. The chief advantage of additional staggering may be to reduce transit crowding in a specific area, thereby attracting some patronage from other vehicles. This strategy also has the disadvantage of requiring widespread coordinated effort by many private individuals and firms. This alone, in a complex and diverse society such as New York City, is an extremely difficult short-term organizational task.

Staggering of business hours has secondary cost implications. Client service is a qualitative factor and by extending the work day for some employees could require extending the work day of other service employees even though they may be operating at less than the normal work load. Switchboard operators, printing and reproduction rooms, and secretarial services are examples. Groups as different as the corporate management and the janitors' union would play an important part in determining the details of such a measure.

5.3.3.3 Strategy Package C

Restrictions of auto use should be coupled with the provision of realistic options for satisfying the trip purpose. The most widely acclaimed and logical answer is an improvement of transit and car pooling. Ways of improving both the system and its use are critical ongoing functions of responsible public agencies. New ways should be continually explored to promote these objectives. The time frame, however, within which new vehicles, new transit systems, and even some operational improvements can be made extends beyond 1977. It has taken more than twenty years of planning to get the Washington transit system under way and it will take at least two more for it to become operational.

The greatest reduction in transit patronage has occurred in the a.m. peak hour. Strategies to counter this trend should be investigated and must consider the role of taxicabs.

Improvement of transit could create costs related to:

a. New graphics at bus stops and in transit stations to explain the system.

b. An educational program to help people understand how to use the system and to effectively market transit services.

c. Programs to facilitate transfers between systems operated by different authorities. This will involve planning and administrative costs.

d. Remodeling of stations could involve replacement of surfaces to make them more vandal-proof or surface changes to brighten them up. It could also involve major reconstruction with the addition of stores and public display areas.

e. Some of the measures would alter the toll structure for bridges and tunnels to finance transit. They could produce an impact on the toll revenue bonds through which many of these facilities have been financed.

f. Studies, closely coordinated with the Transit Authority, should be initiated to determine the most effective method of increasing revenues in transit patronage.

g. Some measures under consideration would eliminate or vary the fares during part of the day or in certain zones. Studies should be made to determine the impact of joyriding or increased use by derelicts and potential impacts upon the patronage and cost of operation, maintenance and security.

h. Cost of installing and operating escalators.

i. Cost of installing, operating and maintaining various intensities and types of lighting.

j. The presence of a city policeman or transit authority security guard is a reassuring factor for most people. It is also very costly. The hours during which patronage is low and stations relatively unused often require the strongest security measures. This places the cost per rider of such services very high.

k. One technique to generate transit patronage is to build park and ride facilities in outlying areas. This could help reduce pollution concentrations but will not eliminate the emissions from cold starts. The net result is to redistribute the pollution in a more decentralized fashion beyond the downtown areas. The exact extent to which utilization of peripheral parking facilities could be stimulated by restrictions imposed within the core area cannot be determined without more sophisticated economic analyses than are possible under this study. The exact extent to which use of peripheral parking facilities could be effective can only be determined by actual demonstration and detailed trip distribution and sensitivity analyses.

5.3.3.4 Strategy Packages D and E

Package D contains short-term goods movement strategies. The New York City Department of Air Resources is in the process of preparing these control measures. Since they would affect many economic issues, they will undoubtedly receive close scrutiny by public officials, labor and management. When the measures are refined and comments have been received from local interest groups who are familiar with the complexity and details of the situation, the social and economic implications could be properly studied. Studies should analyze potential transportation costs due to longer trip lengths, and the man hours required to deliver, receive, store, and protect goods delivered during off hours. For instance, if trucks were required to make deliveries during the evening hours, employers may have to pay overtime to keep workers on hand to handle the merchandise being delivered. This may not efficiently utilize their time.

Some goods must be delivered during the morning rush hours so that they may be sold during the day. Product quality or usefulness may be impaired by changing delivery hours. It could also require businessmen to build or buy new storage facilities. In other cases, highway-oriented commercial enterprises such as parking garages and drive-in service establishments may suffer economic losses due to changes in traffic patterns.

Package E, Capital Construction, relates projects which would not be completed until after 1977. However, an analysis could be made of city and state budgets to determine the projects and programs which could contribute to the improvement of air quality. Perhaps some spin-off benefits from ongoing programs could make a contribution to the State's plan. For instance, in May of 1966 a report of the Tri-State Regional Planning Commission estimated that between 1966 and 1975 the cost of public transportation improvements would be between 1.3 and 2.08 billion dollars. To what extent has this projection been realized and what impact may they have on mobile emissions?

The extent to which Federal agencies will fund transit improvements for new transit cars, buses, mini-buses, etc., is yet to be determined.

5.3.3.5 Strategy Package F - Long-Range Planning

It may be possible in the long term to alter relationships between land use and transportation systems if planning is integrated among all on-going functions of government. Although we cannot expect significant changes in the intensity, distribution, pattern, or types of land use in existing built up areas over the next five years sufficient to influence air quality, planning efforts could be intensified to create more rational and efficient patterns of growth. The region may thus be able to avoid repeating, compounding, and enlarging existing problems. Consideration of air pollution must be integrated into a more comprehensive framework.

To modify the perceived needs of individuals and grounds and to bring about fundamental changes in the alternatives available (i.e., transit versus highway) is a long-term process. This makes it more important to begin immediately to explore and evaluate alternatives. This process could begin with a concerted educational program, designed to encourage public officials, special interest groups and individual citizens to consider our collective future in an urban industrialized society. This is an intellectual, philosophical and long-term view of the task. This fundamental role of education should be cultivated at every level of society. To have this level of involvement an understandable and realistic appraisal is needed of the relative cost and benefits -- social, political, and cultural as well as economic -- of alternative commitments of public resources. Utilizing quantitative analysis where possible, the impact of alternative land use development on transportation, utilities, and public services should be compared to the required investment of both public and private resources and the anticipated returns charted over a time. Perhaps one consequence in New York would be the establishment of development policies which would favor or restrict new construction and redevelopment based upon the carrying capacity of the landscape, the ability of local government to provide utilities and services and the efficiency of land use, energy, consumption, and transportation systems.

Studies could be prepared of the impacts of alternative land use patterns such as: The World Trade Center; Chicago's John Hancock Building; Co-Op City; White Plains, New York; Reston, Virginia; Columbia, Maryland; Levittown, New York.

5.3.4 Determination of Obstacles to Implementation of Control Measures

This report is to lay out strategies which are comprised of control measures, suitable to the character of the New York Metropolitan Region, which would achieve air quality standards set by the Environmental Protection Agency for the year 1977. The purpose of the Environmental Protection Agency and the Council on Environmental Quality is to promote the purpose of the National Environmental Policy Act of 1970. The Act contains a cosmic view of environmental imperatives which should be reflected in national policy and also establishes a mechanism for implementing these lofty purposes.

To comply with the spirit of the Policy Act while pursuing specification standards requires a wise and critical perspective. The Act relates to a relatively new subject and is very new compared to other legislation with impacts of a similar magnitude. The Act is a skeleton which is being fleshed out daily in our courts, the actions of public officials, and the market place of public opinion. Though farsighted individuals have long recognized the seriousness of environmental degradation even prior to the industrial revolution, it is only recently that this growing awareness in our society has manifest itself in legislative action. As a result, much of the data, tools, systems, and methodologies are inadequate to provide the necessary evidence to warrant some of the costly, high impact, and controversial public actions which would theoretically improve environmental quality. This is not to argue for an abdication of the responsibility to act forcefully. It is to point up the need to: overcome the limitations set out in Section 2.0; set realistic priorities for action; and to establish a comprehensive approach to the preservation and regeneration of environmental quality. Both individual opportunities and social well being are related to the degree that this purpose is realized.

6.0 CONTROL STRATEGY IMPLEMENTATION

6.1 PROCEDURE AND TIME SCHEDULE

The detailed procedures and schedules for implementation of several control measures, as developed by the New York City Department of Air Resources, are given in Appendix E. This information provided the primary basis for development of the following outline for this phase of the program:

- Vehicle Turnover

  Implementing Agency: Federal EPA, no local action needed.
  Time to Implement: Currently and continuously underway.

- Heavy-Duty Vehicle Retrofit and Inspection Program

  Implementing Agencies: New York State Department of Transportation with guidance of State Department of Environmental Conservation
  Time to Implement: (assuming legal authority by July 1973)
  Initiation - January 1, 1974
  Completion - January 1975

- Taxi Inspection Program (a legal authority now exists)

  Implementing Agency: New York City Taxi and Limousine Commission.
  Time to Implement: Can be begun four months after administrative approval.

- Personal Automobile Inspection Program (Legal authority now exists - Section 301 of N.Y. State Vehicle & Traffic Law)

  Implementing Agency: State Department of Motor Vehicles with guidance from State Department of Environmental Conservation and NYCDAR.
  Time to Implement: Construction Start - January 1974.
  Inspection Begin - January 1975.

- Flow Improvements (Legal authority now exists)

  Implementing Agencies: NYC Police Department and Traffic Department.
  Time to Implement: Can begin immediately and be implemented within six months.

- Stationary Source Controls (HC) (Legal authority exists)

  Implementing Agency: NYCDAR
  Time to Implement: Can begin immediately.

6.2 AGENCY INVOLVEMENT

Each control strategy could have complex implications for the allocation and management agency resources and manpower. The secondary costs and impacts are more difficult to predict and quantify.

To develop, evaluate, modify, and implement an effective package of interrelated strategies on an interstate basis requires an integration of these activities with the on-going governmental functions of the region. The long-term administrative structure and mechanisms to insure air quality are not yet determined.

Cooperation and coordination will be required among existing public agencies to comply with the 1977 Federal standards. No single agency has the authority or resources to accomplish this themselves. Programs, however, which are budgeted or underway could also help to furnish short-term emissions reduction in addition to the three primary strategies.

There are three levels of inter-agency involvement:

- Detailed agreements to implement the three primary control strategies.
- Analyses of the budgets, special projects, and on-going programs of each public agency to determine the contributions which they could make to the improvement of air quality.
- Coordination of programs, manpower, funds, equipment and other resources to implement secondary control measures. This will require additional quantification of costs and benefits in order to justify the necessary level of inter-agency involvement. Each agency is already burdened with its own responsibilities.

Inter-agency involvement related to the following traffic flow, transportation and land use factors, could influence mobile source emissions:

- Parking policies
- Zoning
- Development plans and policies, for fringe as well as central business districts.

- Enforcement of laws relating to the blocking of intersections, double and illegal parking
- Security for persons and property utilizing public transportation
- Proposed transit equipment, service or operating improvement and changes
- Construction, improvement, or operational changes in freeways or city arterials, including TOPICS projects
- City fleet operations
- City working hours
- Bridge and tunnel tolls
- Grant-in-aid programs
- Demonstration projects
- Public education programs

In a preliminary draft, the New York City Department of Air Resources (NYCDAR) has listed 31 control measures. See Appendix E. Though the strongest committment is to only three vehicle emission control measures, additional reductions may be required from implementation of other measures. The NYCDAR has identified the following agencies as being primarily responsible for the implementation of various strategies. Other governmental agencies would be less directly affected, but are not listed here. This list indicates the potential dimension of inter-agency involvement.

United States Environmental Protection Agency

New York State

    State Legislature
    Department of Motor Vehicles
    Department of Transportation
    Department of Environmental Conservation

New York City

    Taxi and Limousine Commission
    Department of Air Resources
    Traffic Department
    Consumer Affairs
    Transportation Administration
    Bureau of the Budget
    Goods Movement Technical Committee
    City Council
    Police Department
    Metropolitan Transit Authority

Private Bus Operators

Port of New York Authority

Support needed from Mayor's office, Tri-State Regional Planning Commission, and the NYC Department of City Planning

6.3 LEGAL AUTHORITY

At the initial meeting on this task order, it was decided that the legal procedures would be developed by the New York State and City agencies.

6.4 SURVEILLANCE CHECK POINTS

Except for the need to acquire legal authority for the heavy-duty vehicle retrofit program and funding of all programs by the end of 1973, the following surveillance check points are only recommendations and afford considerable latitude in accordance with the preferences of the agencies involved. Figure 6-1 summarizes the check points.

6.4.1 Legal Authority Check Points

At the request of the State and City agencies, these data are being developed by the agency personnel. However, the following check points do appear necessary if the air quality goals are to be met:

- July 1973 - legal authority bills in legislature.
- December 1973 - necessary legal authority available.

6.4.2 Air Quality Check Points

To properly monitor the effects of the control measure implementation, the expanded monitoring system discussed in Section 4.2 should be in operation by January 1, 1974. Afterwards, summary reports of the data obtained should be prepared and evaluated every six months to find whether revisions in the strategy might be required. The responsible agencies are as follows:

- Data Acquisition - NYCDAR
- Summary Report - NYCDAR
- Contact - NYCDAR

Figure 6-1. SURVEILLANCE CHECK POINTS

	1973		1974				1975				1976				1977	
	July	Dec	Jan	March	July	Sept	Jan	March	July	Sept	Jan	March	July	Sept	Jan	July
PHASE I - Initiation																
A. Legislation	●	●														
B. Funding		●														
C. Monitoring Networks																
1. Air Quality			●													
2. Transportation			●													
PHASE II - Monitoring																
A. Control Measures					●		●		●		●		●			Air Quality Standards Met
B. Air Quality				●		●		●		●		●		●		
C. Transportation					●		●		●		●		●			

6.4.3 Transportation Check Points

In order to determine important changes in traffic patterns as they occur, the State Department of Environmental Conservation and NYCDAR should maintain a liaison with such agencies as the Tri-State Regional Planning Commission, the Transportation Planning Division of the New York City Planning Commission and the Port of New York Authority, Summary reports of the inputs from these agencies should be prepared every six months and evaluated together with the air quality reports. These agencies routinely prepare summary reports and in some cases the existing report procedure will be satisfactory. In other cases, only small schedule changes could be required. Responsible agencies are as follows:

- Data Acquisition - agencies are listed in text.
- Summary Reports - NYCDAR
- Contact - NYCDAR

6.4.4 Control Measure Implementation Check Points

The degree of implementation of the control measures should be summarized and evaluated every six months to insure compliance with the overall control strategy. This could best be done by requiring the implementing agencies to make status reports to the State and City air pollution control agencies. The agencies involved are listed below:

- Heavy-Duty Vehicle Program

  Summary Reports - State Departments of Motor Vehicles and Transportation
  Contact - NYCDAR
- Personal Automobile Inspection

  Summary Reports - State Department of Motor Vehicles
  Contact - State Department of Motor Vehicles
- Taxi Inspection

  Summary Reports - Taxi and Limousine Commission
  Contact - Taxi and Limousine Commission

- Traffic Flow Improvements

  Summary Reports - NYC Traffic Department
  Contact - NYC Traffic Department

- Stationary Source Control

  Summary Reports - NYCDAR
  Contact - NYCDAR

APPENDIX A
AIR QUALITY AND EMISSIONS DATA BASE

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A.1 AIR QUALITY DATA BASE

The air quality data upon which the NYC transportation control strategy development has been based were presented and discussed in some detail in Section 4.0. The text of the following material describes the locations of the monitors more precisely and discusses the proportional model used to estimate any necessary emission reductions.

A.1.1 Locations of Air Quality Monitors

The site descriptions of the monitors used for air quality data are as follows:

1. Laboratory - 170 East 121 Street, Manhattan

   This station is located in East Harlen between 3rd and Lexington Avenues on Sylvan Place. It is on a side street which does not have much traffic, although Lexington and 3rd Avenues have fairly heavy traffic. The probes are located approximately 15 feet above the street (35 feet above sea level) on Sylvan Place. CO and NO_x data from this station are considered to represent non-CBD areas of NYC.

2. Laboratory - 51 Astor Place, Manhattan

   This station is on the sixth floor of the Cooper Union Engineering building in lower Manhattan. The oxidant probe is approximately 65 feet above street level hanging out a window on the 9th street side of the building.

3. 59th Street Bridge, Manhattan

   This station is at the Queensborough Bridge Plaza on the Manhattan side of the bridge, on an island separating the Manhattan and Queens bound traffic. The probe is at the height of 5 feet and facing towards the Manhattan-bound traffic. Because of the proximity of the probe both to the ground and the traffic lanes and the low probability of human occupancy of the site for more than brief periods, this location is not considered to be an optimum one for CO.

4. Post Office - 350 Canal Street, Manhattan

   This station is in lower Manhattan at Canal and Church Streets. Canal Street is the major cross-Manhattan street route in the City, with the Holland Tunnel at its west end and the Manhattan Bridge at its east end. The probe hangs out a window on the south side of Canal Street at a height of 8 feet above street level. Data from this station were used for rollback estimates in the downtown Manhattan area.

5. Post Office - 110 East 45th Street, Manhattan

   This station is in midtown Manhattan in the Grand Central Station area. The Post Office is on the south side of 45th Street between Lexington and Vanderbilt Avenues. Forty-fifth Street is a major cross-town traffic route. The height of the probe is 5 feet above street level. Data from this location would be expected to be more representative of midtown Manhattan CO concentrations than station #3. However, to provide a safety factor, the higher CO levels of the latter station were used for the study.

A.1.2 The Proportional Air Quality Model

A simple proportional model was used to determine the source emissions reduction required to achieve air quality standards. The proportional model is based on the assumption that the reduction in air quality concentration levels is directly proportional to emission reductions.

Calculations are as follows:

$$\text{Percentage Reduction} = R = \frac{(gf \times Cmax) - Std + b\,(1 - gf)}{(gf \times Cmax) - gf \times b} \times 100$$

gf = emission growth factor

Cmax = annual highest pollutant concentration in ambient air

Std = ambient air quality standard

b = background

For New York City, the following procedures enabled some simplication of this equation:

- The background concentrations of all pollutants were considered zero.
- Growth of both mobile and stationary sources in later years was incorporated in all emission projections.

The rollback calculation then becomes:

$$R = \frac{Cmax - Std}{Cmax} \times 100$$

A.2 CALCULATION OF EMISSION FACTORS

The method of computing emission factors for motor vehicles in NYC was briefly described in Section 5.0, and this discussion augments that material.

1. Study of the modal distributions for New York City (Section 5.0 and Reference 1, below) indicated that three areas of New York required emission factors specific to those areas:
    - The Downtown Area - shown as Area 1 of Figure A-1.
    - The Midtown Area - shown as Area 2 of Figure A-1.
    - The Rest of NYC - the remainder of Manhattan, the Bronx, Queens, and Brooklyn shown on the figure.
2. The modes to be incorporated in the overall emission factors are listed below:
    - Downtown - personal automobiles, buses (diesel and gasoline), cabs (fleet medallion, non-fleet medallion, and non-medallion), and trucks (diesel and gasoline).
    - Midtown - the same modes as downtown.
    - Rest of NYC - all automobiles, buses (diesel and gasoline), and trucks (diesel and gasoline).
3. Emission factors for private automobiles were calculated following Kircher(2) using the equation below:

$$e_{np} = \sum_{i=n-12}^{n+1} c_i \ d_i \ m_i \ s_i$$

---

(1) "Proposed Plan for Meeting Federal Air Quality Standards Relating to Carbon Monoxide, Hydrocarbons, Nitrogen Oxides, and Oxidants in New York City," NYCDAR, January 1972.

(2) D.S. Kircher and D.P. Armstrong, "AN Interim Report on Motor Vehicle Emission Estimation," Environmental Protection Agency, October 1972.

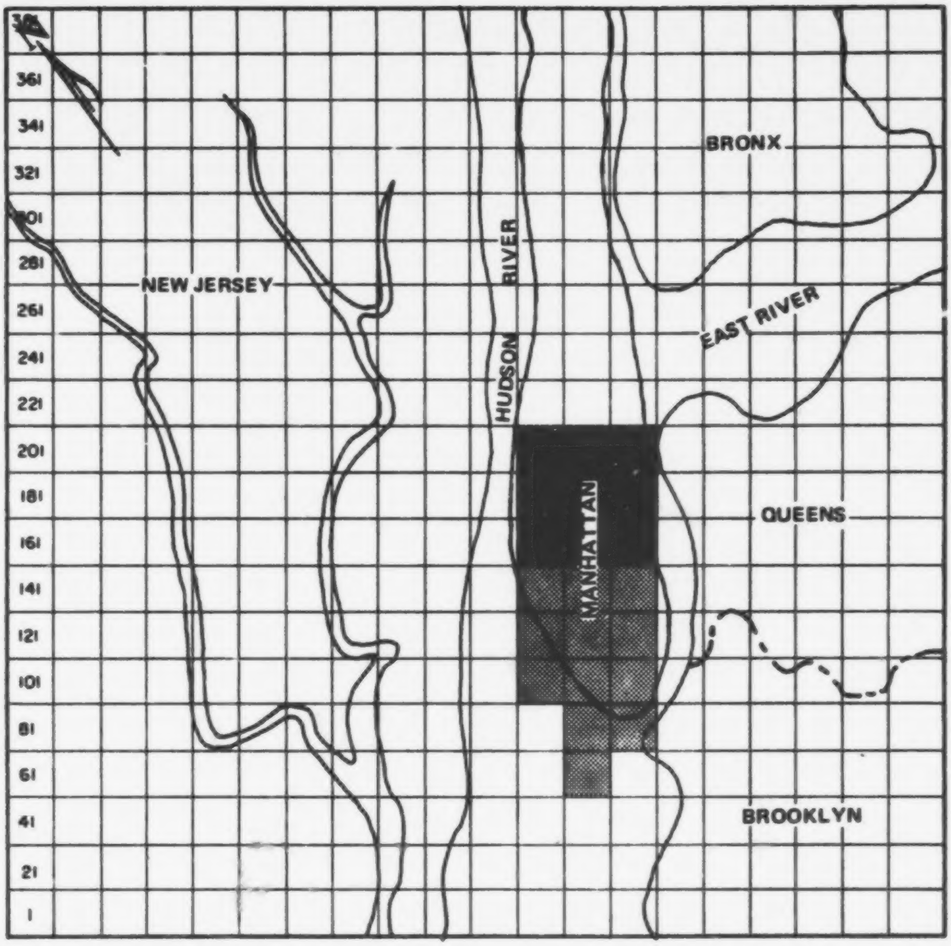
381
361
341
321
301
281
261
241
221
201
181
161
141
121
101
81
61
41
21
1
NEW JERSEY
HUDSON RIVER
MANHATTAN
BRONX
EAST RIVER
QUEENS
BROOKLYN

Figure A-1. ANALYSIS AREAS FOR NEW YORK CITY

LEGEND
DARK = MIDTOWN
LIGHT = DOWNTOWN
WHITE = REST OF NYC GRID

where

e_{np} = emission factor in grams per vehicle mile for calendar year n and pollutant p

C_i = the 1975 Federal test procedure emission rate for pollutant p (grams/mile) for the i^{th} model year, at low mileage

d_i = the control vehicle pollutant p emission deterioration factor for the i^{th} model year at calendar year n

m_i = the weighted annual travel of the i^{th} model year during calendar year n (The determination of this variable involves the use of the vehicle model year distribution.)

s_i = the weighted speed adjustment factor for the i^{th} model year vehicles.

c_i is based on a recent study of light duty vehicle exhaust emission rates in six cities. d_i, deterioration factor accounts for the aging or deterioration of emission control devices. m_i, weighted annual mileage is determined as follows:

$$m_i = \frac{V \times D}{\Sigma V \times D}$$

V = fraction of each model year vehicle in use on December 31 of year

D = average miles driven of each model year vehicle

s_i, speed adjustment factor, varies inversely with average route speed. s_i is greater than one below about 20 m.p.h. and less than one above 20 m.p.h. For New York City, s_i was calculated for each grid square from Tri-State Planning Commission speed data and applied over all modes at the same time.

Age distribution data were taken from Reference 1. The age distributions were assumed to be the same for later years as they were in 1970.

4. Non-fleet medallion cab and non-medallion cab emission factors were calculated in the same way as private automobiles, but the deterioration factors were based on mileage data in Reference 1

assuming that one year is equivalent to 10,000 vehicle miles of travel. However, Mr. Mike Walsh of NYCDAR provided TRW with the results of a recent series of tests on Manhattan fleet medallion cabs. The data are found below:

Model Year	Number Tested	Average Mileage	Emissions (gm/mi)		
			CO	HC	NO_x
Overall	117	60,476	50.6	3.38	7.87
1972	44	23,105	37.6	2.69	9.21
1971	69	79,180	58.5	3.78	7.22
1970	4	148,906	58.5	3.97	4.27

The deterioration factors were not used for determining the weighted emission factors for the latter class of cabs since they were inserted implicitly in the test program. For later years, no test data were available so the calculations were made by use of the same methodology as was used for non-fleet cabs, i.e., the federal emission factors were used with deterioration factors based on mileage.

5. Bus and truck emission factors were taken directly from the New York City Implementation Plan (1) using the basic emission factors, uncorrected for speed. Using the light duty vehicle speed adjustment factors for heavy duty gasoline and diesel vehicles contributes some error, but this is believed to be negligible. However, the lack of speed adjustment factors for these classes and the limitations of the computer program left no other choice.

6. The overall emission factors for each of the three areas were calculated by taking the sums of the modal emission factors weighted by the fractions of total VMT of the individual modes. These fractional VMT contributions are determined by dividing the VMT percentages of Tables 5-1 through 5-3 by 100 percent. The overall emission factors are given in Table 5-4.

7. Because of the vast number of calculations required for computation of a single emission factor, it is not feasible to show them. However, the basic modal emission factors are listed in Tables A-1 and A-2. When applying a control measure to a particular vehicle mode, the measure must be applied to the modal emission factor weighted by VMT. After the application, the weighted sums of the other modal emission factors must be added to obtain the new overall emission factor.

TABLE A-1

BASIC CO MODAL EMISSION FACTORS FOR DOWNTOWN AND MIDTOWN MANHATTAN (gm./mi.)

Mode	1970	1975	1977	References
Personal Automobiles	60.3	34.5	18.8	1,2
Bus - Diesel	34.1	34.1	34.1	2
Bus - Gasoline	158.0	158.0	158.0	2
Taxi - FM	54.4	7.6	5.9	2
Taxi - NFM	61.1	26.3	11.1	1,2
Taxi - NM	70.3	39.1	23.6	1,2
Truck - Diesel	34.1	34.1	34.1	2
Truck - Gasoline	152.1	124.4	109.8	2

Abbreviations: FM=fleet medallion, NFM=non-fleet medallion NM=non-medallion

TABLE A-2

BASIC CO MODAL EMISSION FACTORS FOR UPTOWN MANHATTAN AND OTHER BOROUGHS (gm./mi.)

Mode	1970	1975	1977	References
Automobiles - All	65.9	40.9	26.5	1,2
Bus - Diesel	34.1	34.1	34.1	2
Bus - Gasoline	158.0	158.0	158.0	2
Truck - Diesel	27.8	27.8	27.8	2
Truck - Gasoline	152.1	124.4	109.8	2

TABLE A-3

BASIC HC MODAL EMISSION FACTORS FOR DOWNTOWN AND MIDTOWN MANHATTAN (gm./mi.)

Mode	1970	1975	1977	References
Personal Automobiles	9.75	6.97	2.44	1,2
Bus - Diesel	19.3	19.3	19.3	2
Bus - Gasoline	31.6	31.6	31.6	2
Taxi - FM	6.08	1.30	0.93	2
Taxi - NFM	9.05	3.17	1.54	1,2
Taxi - NM	11.0	4.45	3.05	1,2
Truck - Diesel	17.7	17.7	17.7	2
Truck - Gasoline	30.1	25.7	23.9	2

TABLE A-4

BASIC HC MODAL EMISSION FACTORS FOR UPTOWN MANHATTAN AND OTHER BOROUGHS (gm./mi.)

Mode	1970	1975	1977	References
Automobiles - All	10.8	4.95	1.92	1,2
Bus - Diesel	19.3	19.3	19.3	2
Bus - Gasoline	31.6	31.6	31.6	2
Truck - Diesel	17.7	17.7	17.7	2
Truck - Gasoline	30.1	25.7	23.9	2

TABLE A-5

BASIC NO_x MODAL EMISSION FACTORS FOR DOWNTOWN AND MIDTOWN MANHATTAN (gm./mi.)

Mode	1970	1975	1977	References
Personal Automobiles	3.92	3.14	2.02	1,2
Bus - Diesel	66.2	66.2	66.2	2
Bus - Gasoline	9.6	9.6	9.6	2
Taxi - FM	7.45	2.35	1.05	2
Taxi - NFM	4.10	3.02	1.81	1,2
Taxi - NM	3.61	3.51	2.73	1,2
Truck - Diesel	60.9	60.9	60.9	2
Truck - Gasoline	7.7	7.3	7.05	2

TABLE A-6

BASIC NO_x MODAL EMISSION FACTORS FOR UPTOWN MANHATTAN AND OTHER BOROUGHS (gm./mi.)

Mode	1970	1975	1977	References
Automobiles - All	3.71	3.36	2.02	1,2
Bus - Diesel	66.2	66.2	66.2	2
Bus - Gasoline	9.6	9.6	9.6	2
Truck - Diesel	60.9	60.9	60.9	2
Truck - Gasoline	7.7	7.3	7.05	2

APPENDIX B
TRANSPORTATION DATA BASE

DATA BASE AND METHODOLOGY

B.1 TRANSPORTATION DATA

B.1.1 Basic Data

Basic data were provided by a number of cooperating agencies, especially the Tri-State Regional Planning Commission, the Transportation Planning Division of the New York City Planning Commission and the Port of New York Authority. Specifically, the following key items were obtained from the Tri-State Transportation Commission:

- Vehicle miles traveled for 1970-1977 for each of 127 analysis areas
  (1) By type of roadway
  (2) Average operating speeds
  (3) Estimated speeds for 1977
  (4) Average volume per lane
- Vehicle registrations
- Model for highway needs evaluation
- Hourly vehicular traffic by type
- Flow and volume maps of the region

The New York City Planning Commission provided the following additional inputs:

- Traffic Department vehicle counts from the Annual Cordon Survey for 1965-1971.
- Tunnel and river counts for 1965-1971.
- Twenty-four hour counts by one-hour sequences for major corridors.
- Vehicle population for New York City, 1965-1971.

B.1.2 Disaggregation of New York City Data

In New York City, the initial VMT data provided information classified into only three "Analysis Areas" for all of the Borough of Manhattan. (Data for all the Tri-State analysis areas in both 1970 and 1977 follows this narrative.)

In order to develop data which would more accurately reflect variations in the concentration of VMT, Tri-State provided 1963 VMT data broken down into square-mile units. This provided a basis for disaggregating the three Analysis Areas covering Manhattan into approximately 30 areas. Similar disaggregations were possible for the other Analysis Areas including Manhattan, Bronx, Brooklyn, and Queens Counties in New York and Hudson and Bergen Counties in New Jersey.

Calculation of Manhattan VMT based on these revised square mile data indicated a total of 5,668,820 VMT in 1963 (based on 1964-1965 24-hour weekday traffic counts). This compared to 6,035,850 VMT for 1970 and 6,402,877 VMT for 1977 projections shown by the Tri-State printouts. Conversations with Tri-State indicated that the 1963 square mile VMT of 5.67 million was consistent with their 1970 and 1977 forecasts for Manhattan and were advised that no adjustments would be required in the VMT printouts for 1970 and 1977. The VMT projections for 1984 were made on a gross basis by analysis area through the use of a set of adjustable parameters in the computer program. The VMT growth rates assumed were as follows:

- Analysis area 1/Downtown Manhattan - 0.83 percent per year.
- Analysis area 2/Midtown Manhattan - 0.69 percent per year.
- Rest of grid - 1.15 percent per year.

These percentages were based on the projected growth rate between 1970 and 1977.

A final step in the disaggregation process involved the distribution of 1970, 1977, and 1984 VMT into a square mile distribution. Because no square mile data were available to the project for the period after 1963, the 1970, 1977, and 1984 VMT were distributed on the same percentage basis as the 1963 VMT square mile data. Though this introduced error in the distribution of VMT for the later years, Tri-State advised that the error was relatively small -- e.g., the relative VMT was not substantially different between 1963 and 1970. Unfortunately, the errors introduced had to be accepted since no alternative data were available and all analysis for New York would have had to be eliminated. However, it is quite obvious that land uses have changed in Manhattan since 1963 and some differences in VMT distributions have undoubtedly occurred.

The specific methodology used is enumerated below:

1. The percentage distribution of VMT by square miles was calculated for each Analysis Area to be included in the model. This included a 400 square mile region covering New York and New Jersey.
2. The percentage contribution of each square mile to the total VMT in each Analysis Area was calculated for 1963 and then applied to 1970 and 1977 VMT for each Analysis Area.
3. The use of 1963 VMT percentage distributions per square mile for the 1970 VMT clearly does not incorporate changes in land uses and trip-making since 1963. The application of 1963 square mile distributions to 1977 data, of course, further compounds the error. However, the error will be somewhat confined in view of the fact that the VMT projections by Analysis Areas for 1970 and 1977 themselves take into account the shifts in land use and travel. In Analysis Areas 4 through 7 (The Bronx), VMT between 1970 and 1977 increased by about 4.51 percent (from 5.45 to 5.70 million). This total is disaggregated (by Tri-State) into each of the separate Analysis Areas 4 through 7 and each Analysis Area has a different rate of growth (reflecting the difference in the projected travel expected). The VMT for 1970 and 1977 may be considered reliable in that they reflected by the assumptions and conclusions postulated by the regional transportation planning agency. As previously stated, 1984 VMT projections were made only on a gross basis.

New error is introduced when the 1963 percentage distributions of VMT per square mile are applied to each of the Analysis Areas. However, without data on changes in land use, floor space or some other variable related to trip-making, there was no way to correct the error.

B.1.3 Stationary Sources

County data were available for New York giving the 1970 and 1977 emissions for each pollutant due to stationary sources from Mr. David Kircher of EPA. These county totals were apportioned to the grid areas using the VMT for each grid as an apportioning factor.

1970 TRAFFIC DATA

```
ECON^^IC EVALUATION OF HIGHWAY NETWORK

HIGHWAY EVALUATION FOR THE YEAR 1970  BASED ON FIXED SUPPLY  1  USING PROJECTION 1

TIME VALUED AT 2.50 DOLLARS PER HOUR.
BASED ON INTEREST RATE OF 10 PERCENT AND ECONOMIC LIFE OF 25 YEARS.

CONST. COST FACTOR IS  1.300


EXP ACC COST IS  1470. ART ACC COST IS  1250.
RELOCATION COST IS  10000. PER HH.   VEHOP COST FACTOR IS   1.00


ADJUSTMENTS    SPDEXP  SPDART  SPDLOC  ACCEXP  ACCAL
                1.00    1.00    1.00    1.00    1.00                MAINT COST PER MILE IS     33000.


VMT EQUATION    VMT=    0. + 64.3 *VTE**0.74 *2.718**( 1.6 *FE/FOM



  FIELD   0 NOT IN RANGE


  FIELD   0 NOT IN RANGE
```

INSTITUTE OF PUBLIC ADMINISTRATION
[illegible] MASSACHUSETTS AVE NW • WASHINGTON DC [illegible]
[illegible]

CODE: B - 1 New York City
2 New York Suburbs
3 New Jersey
4 Conn.

B- counties

AA-zones

999-summary

```
  S   C  AA              VMT - EXP     VMT - ART     VMT - LOC   VMT - TOTAL

  1   1   1               1203399.      1271025.      280559.      2754983.          *          *
  1   1   2                550652.       698931.      181526.      1431110.          *          *
  1   1   3                611240.       450516.       86377.      1148133.          *          *
  1   1 999               2365291.      2420471.      548462.      5334226.          *          *

  1   2   4               1064677.       880920.      356145.      2301743.          *          *
  1   2   5                694113.       232475.      130445.      1057033.          *          *
  1   2   6                617056.       521127.      233459.      1371641.          *          *
  1   2   7                461704.       326190.      177449.       965344.          *          *
  1   2 999               2837548.      1960711.      897498.      5696210.          *          *

  1   3   8                900072.      1274479.      574327.      2748880.          *          *
  1   3   9                 10767.       757924.      343959.      1112649.          *          *
  1   3  10                701998.       783128.      384176.      1869302.          *          *
  1   3  11                666473.      1075666.      509571.      2251710.          *          *
  1   3 999               2279310.      3691196.     1812032.      7782541.          *          *

  1   4  12                463051.       134362.       84822.       682735.          *          *
  1   4  13               1869780.      1693090.      842671.      4405541.          *          *
  1   4  14               1801030.      1513187.      814102.      4128319.          *          *
  1   4  15               1764774.      1656752.      817957.      4239483.          *          *
  1   4 999               5898634.      4997390.     2559551.     13455579.          *          *

  1   5  16                321323.       240989.      106831.       669143.          *          *
  1   5  17                185235.       533089.      280026.       998350.          *          *
  1   5  18                257448.       284543.      166139.       708130.          *          *
  1   5 999                764006.      1058620.      552996.      2375622.          *          *

  1  99 999              14144789.     14328388.     6370968.     34844140.          *          *
```

```
S    C  AA              VMT - EXP     VMT - ART     VMT - LOC     VMT - TOTAL

2    6  19               311874.       1192542.       592363.      2096779.      .      .
2    6  20               862661.       1283471.       657373.      2803506.      .      .
2    6  21               584042.       2002967.      1070041.      3657051.      .      .
2    6  22               726178.        918647.       392109.      2036934.      .      .
2    6  23              1437790.       1778119.       984431.      4200341.      .      .
2    6  24               818502.        529092.       335618.      1683212.      .      .
2    6 999              4741045.       7704837.      4031932.     16477823.      .      .

2    7  25               480917.        741344.       412118.      1634378.      .      .
2    7  26               966502.       1035508.       626054.      2628065.      .      .
2    7  27              1722749.       1076983.       717635.      3517369.      .      .
2    7  28              1306602.       1619711.       876688.      3803002.      .      .
2    7  29               850136.        904309.       492416.      2246862.      .      .
2    7  30               210747.         78777.        49537.       339061.      .      .
2    7  31               980633.       1737530.       860532.      3578698.      .      .
2    7  32               638766.        464721.       224856.      1328343.      .      .
2    7  33               319649.        209472.       122953.       651975.      .      .
2    7  34               640689.        551608.       271301.      1463598.      .      .
2    7 999              8117384.       8419962.      4653988.     21191312.      .      .

2    8  35               881109.        671380.       400669.      1953158.      .      .
2    8  36              1831998.       1107940.       634497.      3574437.      .      .
2    8  37              1153368.        851588.       436981.      2441937.      .      .
2    8  38                    0.        198728.        92573.       291302.      .      .
2    8  39               820448.        747786.       374647.      1942881.      .      .
2    8  40               522740.        402758.       233555.      1159053.      .      .
2    8  41               706485.        702850.       384908.      1794244.      .      .
2    8  42               243977.        281573.       155647.       681197.      .      .
2    8 999              6160123.       4964599.      2713473.     13838207.      .      .

2    9  43               594797.        523665.       242835.      1361296.      .      .
2    9  44               633280.        607795.       309210.      1550286.      .      .
2    9  45                85746.        200018.        80188.       365951.      .      .
2    9  46               257891.        231332.       128555.       617779.      .      .
2    9 999              1571712.       1562808.       760788.      3895311.      .      .

2   10  47               253502.        558593.       292944.      1105040.      .      .
2   10  48               321334.        340588.       196378.       858300.      .      .
2   10 999               574836.        899181.       489322.      1963339.      .      .

2   11  49               514590.        510072.       312998.      1337660.      .      .
2   11  50               117723.        593899.       290986.      1002608.      .      .
2   11  51               439761.       1193906.       640056.      2273724.      .      .
2   11  52               121377.        590283.       303616.      1015276.      .      .
2   11  53               170756.        798735.       413303.      1382794.      .      .
2   11  54               183381.        285125.       159319.       627825.      .      .
2   11 999              1547585.       3972017.      2120275.      7639886.      .      .

2   12  55                78336.        638747.       306922.      1023946.      .      .
2   12  56               838490.        894384.       472578.      2205454.      .      .
2   12  57               454335.        447041.       274969.      1176345.      .      .
2   12  58               409593.        643833.       352268.      1405693.      .      .
2   12  59               554938.        674701.       347785.      1577434.      .      .
2   12  60               657993.        999611.       526514.      2184119.      .      .
2   12 999         300[illegible]631.   [illegible]       2275434.   [illegible]      .      .
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S    C  AA                          VMT - EXP     VMT - ART     VMT - LOC     VMT - TOTAL

 2  99 999                         25721280.     31811808.     17045696.     74578784.
```

```
S    C  AA                    VMT - EXP     VMT - ART      VMT - LOC    VMT - TOTAL

 3  13  61                     676196.       658932.        299756.      1634883.       *         *
 3  13  62                     993429.       708699.        314905.      2017033.       *         *
 3  13  63                     245846.       135114.         65668.       446629.       *         *
 3  13 999                    1915471.      1502744.        680329.      4098545.       *         *

 3  14  64                    1486125.      1147601.        476466.      3110192.       *         *
 3  14  65                     763272.       934809.        442166.      2140247.       *         *
 3  14  66                     240602.       804680.        381643.      1426925.       *         *
 3  14  67                     221008.       569939.        280179.      1071126.       *         *
 3  14 999                    2711005.      3457028.       1580452.      7748490.       *         *

 3  15  68                    1892943.      1400528.        683437.      3976908.       *         *
 3  15  69                     661326.       707129.        432889.      1801344.       *         *
 3  15  70                    1246607.      1339717.        736066.      3322390.       *         *
 3  15  71                     372305.      1028407.        533556.      1934269.       *         *
 3  15  72                     640451.       416597.        209281.      1266328.       *         *
 3  15 999                    4813630.      4892377.       2595226.     12301239.       *         *

 3  16  73                    1328090.      1086991.        613632.      3028714.       *         *
 3  16  74                     279415.       546431.        287243.      1113088.       *         *
 3  16  75                          1.       800331.        372357.      1172689.       *         *
 3  16 999                    1607504.      2433753.       1273231.      5314491.       *         *

 3  17  76                    1451022.      1047467.        526291.      3024780.       *         *
 3  17  77                     665162.       791196.        405559.      1861919.       *         *
 3  17  78                     640008.       624808.        341014.      1605831.       *         *
 3  17  79                     179961.       593357.        305721.      1079038.       *         *
 3  17  80                          1.       662060.        307369.       969430.       *         *
 3  17 999                    2936152.      3718886.       1885953.      8540998.       *         *

 3  18  81                     455672.       821671.        378045.      1655387.       *         *
 3  18  82                     228477.       552119.        292263.      1072859.       *         *
 3  18  83                     970897.       997443.        527846.      2496186.       *         *
 3  18  84                     118281.       645437.        327508.      1091226.       *         *
 3  18 999                    1773325.      3016670.       1525661.      6315658.       *         *

 3  19  85                     831644.       684599.        350031.      1866275.       *         *
 3  19  86                    1088738.       747271.        338775.      2174785.       *         *
 3  19  87                          1.      1477958.        683146.      2161106.       *         *
 3  19 999                    1920382.      2909827.       1371952.      6202166.       *         *

 3  20  88                    2236472.      1435428.        724704.      4396606.       *         *
 3  20  89                     394339.       918631.        479932.      1792902.       *         *
 3  20  90                     459180.       580310.        284091.      1323581.       *         *
 3  20  91                     757872.       676872.        309712.      1744456.       *         *
 3  20  92                     467485.       457327.        214692.      1139504.       *         *
 3  20  93                     383702.       589604.        311563.      1284869.       *         *
 3  20 999                    4699046.      4658169.       2324693.     11681918.       *         *

 3  21  94                     405227.       911934.        483448.      1800609.       *         *
 3  21  95                          0.       541770.        260047.       801817.       *         *
 3  21  96                     212105.       243839.        100658.       556602.       *         *
 3  21  97                     302892.       656267.        348706.      1307865.       *         *
 3  21  98                     726243.       766312.        433700.      1926255.       *         *
 3  21  99                     213227.       366661.        178422.       758310.       *         *
 3  21 100                     429003.       580604.        281613.      1291219.       *         *
```

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                                   2547598.     4603129.     [illegible]     [illegible]

S    C  AA                         VMT - EXP    VMT - ART    VMT - LOC    VMT - TOTAL

3   22 102                           883575.      721103.      406324.      2011002.
3   22 103                                1.     1125290.      533603.      1658894.
3   22 104                           510048.     1599265.      857164.      2966479.
3   22 999                          1393623.     3445658.     1797091.      6636375.

3   99 999                         26317696.    34318816.    17247024.     77883600.
```

S	C	AA	VMT - EXP	VMT - ART	VMT - LOC	VMT - TOTAL
4	23	105	363135.	388122.	212448.	963705.
4	23	106	308682.	348800.	181667.	839150.
4	23	107	455230.	657440.	350009.	1462679.
4	23	108	299433.	412675.	220160.	932268.
4	23	109	900428.	644615.	353964.	1899007.
4	23	999	2326908.	2451649.	1318247.	6096808.
4	24	110	144303.	543906.	273762.	961971.
4	24	111	372507.	334380.	195496.	902382.
4	24	112	997209.	827344.	464138.	2288691.
4	24	999	1514018.	1705629.	933396.	4153044.
4	25	113	347329.	519247.	268759.	1135335.
4	25	999	347329.	519247.	268759.	1135335.
4	26	114	762156.	690717.	370982.	1823855.
4	26	115	845679.	583258.	275418.	1704355.
4	26	116	430159.	632856.	324729.	1387744.
4	26	117	255577.	468665.	242844.	967087.
4	26	118	575452.	676322.	338462.	1590237.
4	26	119	59845.	239844.	115531.	415221.
4	26	120	1088761.	591567.	305583.	1985912.
4	26	999	4017627.	3883227.	1973548.	9874409.
4	27	121	333647.	889222.	457326.	1680195.
4	27	122	1038339.	1529153.	853535.	3421028.
4	27	123	234723.	441979.	253850.	930552.
4	27	999	1606708.	2860352.	1564711.	6031775.
4	28	124	303499.	302975.	187308.	793782.
4	28	125	284892.	275880.	165940.	726713.
4	28	126	353828.	646484.	358143.	1358455.
4	28	127	1.	767721.	358025.	1125747.
4	28	999	942219.	1993060.	1069416.	4004696.
4	99	999	10754808.	13413164.	7128076.	31296032.

```
S    C  AA                    VMT - EXP      VMT - ART      VMT - LOC     VMT - TOTAL

9  99 999                     76938560.      93872160.      47791760.     218602576.
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```
ECONOMIC EVALUATION OF HIGHWAY NETWORK

HIGHWAY EVALUATION FOR THE YEAR 1977  BASED ON FIXED SUPPLY  1  USING PROJECTION 1

TIME VALUED AT 2.50 DOLLARS PER HOUR.
BASED ON INTEREST RATE OF 10 PERCENT AND ECONOMIC LIFE OF 25 YEARS.

CONST. COST FACTOR IS  1.300


EXP ACC COST IS  1470. ART ACC COST IS  1250.
RELOCATION COST IS  10000. PER HH.   VEHOP COST FACTOR IS   1.00


ADJUSTMENTS    SPDEXP  SPDART  SPDLOC  ACCEXP  ACCAL
                1.00    1.00    1.00    1.00    1.00                MAINT COST PER MILE IS     33000.


VMT EQUATION    VMT=    0. + 64.3 *VTE**0.74 *2.718**( 1.6 *FE/FOM


    FIELD   0 NOT IN RANGE


    FIELD   0 NOT IN RANGE
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S    C  AA                      EXPWY SPEED   ARTERL SPEED    LOCAL SPEED        SPEED

1    1   1                          36.10          10.60           5.13          13.25        *          *
1    1   2                          36.36          13.26           7.13          15.34        *          *
1    1   3                          42.09          16.50           8.31          21.09        *          *
1    1 999                          37.54          12.11           6.05          15.09        *          *

1    2   4                          39.73          15.73           8.74          18.63        *          *
1    2   5                          44.13          19.14          10.79          26.45        *          *
1    2   6                          40.89          17.67          10.46          20.50        *          *
1    2   7                          43.44          19.46          11.15          22.28        *          *
1    2 999                          41.58          17.14           9.86          20.81        *          *

1    3   8                          38.22          14.91           8.74          15.73        *          *
1    3   9                          38.65          14.87           9.46          12.70        *          *
1    3  10                          41.57          17.18           9.40          16.09        *          *
1    3  11                          41.88          18.20          10.22          18.03        *          *
1    3 999                          40.25          16.13           9.40          16.27        *          *

1    4  12                          47.52          23.14          12.75          30.73        *          *
1    4  13                          39.47          15.73           9.55          18.11        *          *
1    4  14                          41.88          17.92          10.62          20.22        *          *
1    4  15                          41.23          17.92          10.71          20.03        *          *
1    4 999                          41.27          17.21          10.32          19.75        *          *

1    5  16                          46.62          23.61          13.20          26.57        *          *
1    5  17                          45.38          20.83          11.90          18.77        *          *
1    5  18                          47.54          24.20          14.05          24.42        *          *
1    5 999                          46.61          22.26          12.73          22.12        *          *

1   99 999                          40.74          16.04           9.57          18.28        *          *
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S	C	AA	EXPWY SPEED	ARTERL SPEED	LOCAL SPEED	SPEED		
2	6	19	43.27	19.74	12.19	18.04	•	•
2	6	20	41.69	18.02	10.85	18.38	•	•
2	6	21	43.45	18.21	11.25	16.73	•	•
2	6	22	45.93	24.58	14.45	25.36	•	•
2	6	23	43.87	19.46	11.10	19.73	•	•
2	6	24	46.58	22.22	12.22	24.45	•	•
2	6	999	44.10	19.55	11.60	19.40	•	•
2	7	25	47.89	24.25	13.67	23.10	•	•
2	7	26	45.53	21.31	12.50	21.92	•	•
2	7	27	47.42	23.66	13.50	26.06	•	•
2	7	28	46.64	23.77	14.00	23.95	•	•
2	7	29	46.89	23.97	13.94	24.64	•	•
2	7	30	50.42	27.53	16.38	33.69	•	•
2	7	31	48.73	27.34	16.24	26.18	•	•
2	7	32	51.06	30.03	17.54	32.56	•	•
2	7	33	53.07	31.83	18.42	33.83	•	•
2	7	34	52.47	31.92	18.70	33.26	•	•
2	7	999	48.09	25.04	14.48	25.64	•	•
2	8	35	43.85	19.20	10.86	21.24	•	•
2	8	36	44.46	20.18	11.38	23.53	•	•
2	8	37	45.73	22.37	12.70	24.99	•	•
2	8	38	52.46	31.99	19.68	26.69	•	•
2	8	39	46.46	23.85	13.91	25.58	•	•
2	8	40	51.06	29.53	17.36	31.05	•	•
2	8	41	48.24	26.02	15.34	26.88	•	•
2	8	42	52.20	31.40	18.69	31.00	•	•
2	8	999	46.06	23.08	13.20	24.96	•	•
2	9	43	46.62	24.27	14.00	26.34	•	•
2	9	44	48.11	25.76	14.80	26.89	•	•
2	9	45	46.61	26.17	15.30	24.85	•	•
2	9	46	52.86	32.25	19.11	32.90	•	•
2	9	999	48.15	26.05	15.15	27.27	•	•
2	10	47	51.98	31.50	19.21	29.19	•	•
2	10	48	53.63	33.15	19.73	32.73	•	•
2	10	999	52.89	32.11	19.41	30.64	•	•
2	11	49	50.41	28.60	17.15	28.89	•	•
2	11	50	50.80	30.33	18.79	26.82	•	•
2	11	51	47.18	24.34	15.16	22.60	•	•
2	11	52	53.92	33.87	20.99	29.74	•	•
2	11	53	51.18	29.79	18.45	26.31	•	•
2	11	54	55.90	36.75	22.39	34.58	•	•
2	11	999	50.38	28.69	17.68	26.42	•	•
2	12	55	51.44	30.93	18.97	26.70	•	•
2	12	56	51.89	31.17	18.49	31.32	•	•
2	12	57	53.43	32.85	19.72	32.63	•	•
2	12	58	51.48	30.40	18.28	29.04	•	•
2	12	59	49.31	28.02	16.64	28.15	•	•
2	12	60	49.60	26.01	16.69	27.19	•	•
2	12	999	51.03	29.87	17.91	29.04	•	•

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S   C  AA                EXPWY SPEED   ARTERL SPEED   LOCAL SPEED      SPEED

 2  99 999                   47.35         24.18          14.24          24.41
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S	C	AA	EXPWY SPEED	ARTERL SPEED	LOCAL SPEED	SPEED		
3	13	61	41.03	18.08	10.72	20.21	*	*
3	13	62	41.72	18.06	10.51	21.69	*	*
3	13	63	44.84	20.10	10.56	24.24	*	*
3	13	999	41.85	18.23	10.61	21.31	*	*
3	14	64	39.85	16.34	9.40	19.66	*	*
3	14	65	43.07	19.43	10.77	20.02	*	*
3	14	66	44.28	22.13	13.38	20.29	*	*
3	14	67	44.83	21.50	12.36	19.79	*	*
3	14	999	41.47	19.08	11.06	19.89	*	*
3	15	68	41.50	17.64	10.11	20.65	*	*
3	15	69	44.02	18.89	10.86	19.51	*	*
3	15	70	42.87	18.57	10.79	19.61	*	*
3	15	71	45.09	21.48	12.97	19.88	*	*
3	15	72	49.26	26.89	15.20	29.96	*	*
3	15	999	43.37	19.39	11.25	20.71	*	*
3	16	73	42.79	18.06	10.13	19.95	*	*
3	16	74	45.05	21.56	12.78	20.60	*	*
3	16	75	50.21	29.10	18.13	24.41	*	*
3	16	999	43.17	21.53	12.30	20.94	*	*
3	17	76	46.76	24.26	14.11	27.13	*	*
3	17	77	47.32	25.01	14.61	25.35	*	*
3	17	78	48.67	26.30	15.27	27.11	*	*
3	17	79	50.36	29.05	17.80	26.21	*	*
3	17	80	51.37	30.73	19.05	25.73	*	*
3	17	999	47.50	26.46	15.63	26.44	*	*
3	18	81	40.75	17.95	10.60	17.87	*	*
3	18	82	42.23	17.98	11.48	17.42	*	*
3	18	83	43.83	20.31	11.86	21.56	*	*
3	18	84	43.96	19.33	11.94	17.18	*	*
3	18	999	42.80	18.98	11.47	18.94	*	*
3	19	85	47.31	24.95	14.47	26.97	*	*
3	19	86	49.13	27.58	16.00	30.88	*	*
3	19	87	46.75	24.93	15.93	21.15	*	*
3	19	999	48.32	25.57	15.55	25.65	*	*
3	20	88	44.31	21.12	12.30	24.79	*	*
3	20	89	45.09	21.75	13.20	20.53	*	*
3	20	90	46.49	24.46	14.40	24.82	*	*
3	20	91	45.09	22.72	13.17	24.88	*	*
3	20	92	49.63	28.25	16.35	29.41	*	*
3	20	93	47.59	25.52	15.35	24.97	*	*
3	20	999	45.45	22.95	13.52	24.42	*	*
3	21	94	45.78	22.56	13.72	21.30	*	*
3	21	95	46.42	22.35	14.09	18.78	*	*
3	21	96	52.52	33.02	19.59	33.61	*	*
3	21	97	46.25	22.47	12.98	20.69	*	*
3	21	98	47.76	24.63	14.10	24.99	*	*
3	21	99	50.36	29.14	17.26	27.90	*	*
3	21	100	51.28	30.49	17.47	29.91	*	*

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                     48.83         25.10         14.[illegible]    [illegible]        *          *

S    C  AA      EXPWY SPEED   ARTERL SPEED   LOCAL SPEED       SPEED

3   22 102           47.50         24.88         14.62         26.68        *          *
3   22 103           45.51         22.29         14.88         19.21        *          *
3   22 104           44.22         20.22         13.21         19.07        *          *
3   22 999           46.24         21.73         13.98         20.92        *          *

3   99 999           44.75         21.79         12.94         22.28        *          *
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S   C  AA              EXPWY SPEED  ARTERL SPEED   LOCAL SPEED      SPEED

4  23 105                  44.22         20.78         12.39         21.89        *        *
4  23 106                  49.12         27.91         16.81         28.36        *        *
4  23 107                  43.20         19.38         11.54         19.55        *        *
4  23 108                  50.03         28.62         17.13         28.03        *        *
4  23 109                  45.84         22.51         12.98         25.14        *        *
4  23 999                  45.93         22.67         13.40         23.70        *        *

4  24 110                  49.16         27.51         16.77         24.65        *        *
4  24 111                  46.50         23.10         13.43         24.36        *        *
4  24 112                  43.70         19.56         11.22         21.50        *        *
4  24 999                  44.84         22.28         12.92         22.75        *        *

4  25 113                  47.52         25.30         14.94         24.78        *        *
4  25 999                  47.52         25.30         14.94         24.78        *        *

4  26 114                  45.45         22.59         13.38         24.30        *        *
4  26 115                  43.61         20.08         11.25         23.37        *        *
4  26 116                  46.05         23.77         14.25         23.62        *        *
4  26 117                  47.76         26.17         16.03         25.18        *        *
4  26 118                  48.49         27.03         16.05         27.43        *        *
4  26 119                  51.76         32.18         19.88         28.79        *        *
4  26 120                  47.29         24.38         14.06         28.78        *        *
4  26 999                  46.23         24.13         14.22         25.54        *        *

4  27 121                  48.06         26.55         16.58         24.70        *        *
4  27 122                  46.57         23.64         14.35         23.36        *        *
4  27 123                  51.43         29.82         18.12         27.87        *        *
4  27 999                  47.53         25.32         15.48         24.33        *        *

4  28 124                  52.17         30.87         18.48         30.81        *        *
4  28 125                  51.29         29.95         17.98         30.28        *        *
4  28 126                  48.41         26.02         15.84         24.80        *        *
4  28 127                  49.62         28.55         18.18         24.17        *        *
4  28 999                  50.44         28.17         17.34         26.50        *        *

4  99 999                  46.53         24.39         14.54         24.62        *        *
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S    C  AA                    EXPWY SPEED   ARTERL SPEED   LOCAL SPEED       SPEED

9   99 999                         45.00          21.66          12.97       22.47
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ECONOMIC EVALUATION OF HIGHWAY NETWORK

HIGHWAY EVALUATION FOR THE YEAR 1977  BASED ON FIXED SUPPLY  1  USING PROJECTION 1

TIME VALUED AT 2.50 DOLLARS PER HOUR.
BASED ON INTEREST RATE OF 10 PERCENT AND ECONOMIC LIFE OF 25 YEARS.

CONST. COST FACTOR IS  1.300


EXP ACC COST IS  1470. ART ACC COST IS  1250.
RELOCATION COST IS  10000. PER HH.   VEHOP COST FACTOR IS   1.00


ADJUSTMENTS    SPDEXP  SPDART  SPDLOC  ACCEXP  ACCAL
                1.00    1.00    1.00    1.00    1.00                MAINT COST PER MILE IS     33000.

VMT EQUATION    VMT=    0. + 64.3 *VTE**0.74 *2.718**( 1.6 *FE/FO


   FIELD   0 NOT IN RANGE


   FIELD   0 NOT IN RANGE
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S	C	AA	VMT - EXP	VMT - ART	VMT - LOC	VMT - TOTAL		
1	1	1	1251087.	1324823.	286102.	2862012.	•	•
1	1	2	572086.	725381.	188209.	1485677.	•	•
1	1	3	614642.	452949.	86826.	1154416.	•	•
1	1	999	2437815.	2503152.	561136.	5502105.	•	•
1	2	4	1034752.	892576.	362636.	2289965.	•	•
1	2	5	628348.	229885.	124121.	982355.	•	•
1	2	6	598577.	490875.	215685.	1305136.	•	•
1	2	7	436175.	287155.	152567.	875896.	•	•
1	2	999	2697849.	1900488.	855009.	5453351.	•	•
1	3	8	867928.	1229444.	554225.	2651599.	•	•
1	3	9	10493.	729314.	330126.	1069933.	•	•
1	3	10	675820.	754167.	370074.	1800061.	•	•
1	3	11	669005.	1072510.	505323.	2246838.	•	•
1	3	999	2223245.	3785434.	1759737.	7768421.	•	•
1	4	12	387376.	101806.	70541.	559723.	•	•
1	4	13	1828695.	1609873.	799568.	4238138.	•	•
1	4	14	1775075.	1478812.	797732.	4051620.	•	•
1	4	15	1624632.	1697126.	846870.	4168629.	•	•
1	4	999	5615777.	4887617.	2514709.	13018109.	•	•
1	5	16	170747.	232656.	104126.	507529.	•	•
1	5	17	36961.	558232.	269761.	864974.	•	•
1	5	18	17145.	325097.	157077.	499319.	•	•
1	5	999	224853.	1115984.	530984.	1871822.	•	•
1	99	999	13199539.	14192675.	6221574.	33613776.	•	•

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S   C  AA            VMT - EXP     VMT - ART     VMT - LOC    VMT - TOTAL

2   6  19              294092.      1103070.       552502.      1949664.      *      *
2   6  20              834648.      1242154.       636373.      2713176.      *      *
2   6  21              548434.      1860201.      1004529.      3413165.      *      *
2   6  22              489762.       878220.       373124.      1741105.      *      *
2   6  23             1385575.      1714126.       949288.      4048990.      *      *
2   6  24              698318.       522671.       327343.      1548332.      *      *
2   6 999             4250820.      7320441.      3843156.     15414432.      *      *

2   7  25              440011.       666718.       367876.      1474606.      *      *
2   7  26              650122.      1073226.       629413.      2352761.      *      *
2   7  27             1336023.       986133.       657964.      2980121.      *      *
2   7  28              556203.      1388272.       736381.      2680857.      *      *
2   7  29              495987.       733704.       387082.      1616773.      *      *
2   7  30              157342.        46328.        33252.       236921.      *      *
2   7  31              719222.      1274414.       604897.      2598534.      *      *
2   7  32               22529.       525428.       237890.       785848.      *      *
2   7  33              222467.       205377.       119950.       547794.      *      *
2   7  34                   1.       702725.       316112.      1018838.      *      *
2   7 999             4599901.      7602322.      4090811.     16293051.      *      *

2   8  35              836816.       619958.       374784.      1831558.      *      *
2   8  36             1645973.       935471.       548388.      3129833.      *      *
2   8  37             1019527.       734671.       364550.      2118747.      *      *
2   8  38                   0.       155449.        72864.       228314.      *      *
2   8  39              659599.       543592.       274903.      1478094.      *      *
2   8  40              295114.       385792.       219688.       900594.      *      *
2   8  41              571749.       501263.       285821.      1358833.      *      *
2   8  42              154732.       215306.       122310.       492348.      *      *
2   8 999             5183506.      4091500.      2263305.     11538319.      *      *

2   9  43              481594.       414241.       175235.      1071070.      *      *
2   9  44              539244.       508262.       251321.      1298827.      *      *
2   9  45               66023.       148236.        55860.       270119.      *      *
2   9  46              235888.       199963.       112517.       548368.      *      *
2   9 999             1322748.      1270700.       594934.      3188383.      *      *

2  10  47              201897.       396064.       217131.       815092.      *      *
2  10  48              251624.       251449.       147019.       650091.      *      *
2  10 999              453521.       647513.       364149.      1465183.      *      *

2  11  49              417981.       363566.       238289.      1019836.      *      *
2  11  50               88765.       393380.       200671.       682816.      *      *
2  11  51              373499.       911490.       505398.      1790387.      *      *
2  11  52              100354.       460937.       244694.       805985.      *      *
2  11  53              140940.       572490.       304833.      1018262.      *      *
2  11  54              149461.       216709.       127390.       493560.      *      *
2  11 999             1270998.      2918570.      1621272.      5810845.      *      *

2  12  55               63299.       456800.       223204.       743303.      *      *
2  12  56              647853.       647650.       333660.      1629163.      *      *
2  12  57              195892.       365551.       225867.       787309.      *      *
2  12  58              170897.       580450.       306162.      1057509.      *      *
2  12  59              120072.       570572.       277414.       968058.      *      *
2  12  60              403841.       887031.       462365.      1753237.      *      *
2  12 999             1601853.      3508052.      1828670.      6938579.      *      *
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5    C  AA                    VMT - EXP     VMT - ART     VMT - LOC    VMT - TOTAL

2  99 999                    18683328.     27359056.     14606296.      60648720.
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S    C  AA           VMT - EXP     VMT - ART     VMT - LOC    VMT - TOTAL

3   13   61           663655.       631384.       283490.      1578529.
3   13   62           867378.       678760.       311558.      1857695.
3   13   63           151558.       151192.        75035.       377784.
3   13  999          1682589.      1461335.       670083.      3814008.

3   14   64          1174166.      1231629.       535277.      2941074.
3   14   65           557050.      1035859.       494015.      2086924.
3   14   66                0.       773095.       346664.      1119758.
3   14   67            67405.       606184.       284061.       957649.
3   14  999          1798620.      3646764.      1660015.      7105405.

3   15   68          1430529.      1251123.       603861.      3285514.
3   15   69           592603.       604797.       381060.      1578460.
3   15   70           700885.      1502898.       788213.      2991997.
3   15   71           277152.       783513.       413389.      1474054.
3   15   72                0.       632410.       285492.       917902.
3   15  999          3001168.      4774740.      2472013.     10247927.

3   16   73          1090024.      1059581.       599817.      2749423.
3   16   74                0.       573587.       267822.       841409.
3   16   75                1.       583226.       274795.       858022.
3   16  999          1090024.      2216393.      1142433.      4448853.

3   17   76           793954.       871824.       438937.      2104715.
3   17   77            95833.       788338.       381485.      1265655.
3   17   78           506159.       496351.       277729.      1280238.
3   17   79                0.       508172.       241181.       749354.
3   17   80                1.       474311.       222993.       697305.
3   17  999          1395945.      3138993.      1562321.      6097265.

3   18   81           431347.       778232.       358228.      1567807.
3   18   82           209459.       495744.       267510.       972713.
3   18   83           422749.      1206303.       606428.      2235481.
3   18   84           114936.       615930.       313415.      1044281.
3   18  999          1178490.      3096208.      1545580.      5820282.

3   19   85           568697.       606283.       305399.      1480380.
3   19   86           865215.       505663.       220539.      1591418.
3   19   87                1.       950010.       439660.      1389671.
3   19  999          1433912.      2061956.       965598.      4461469.

3   20   88          1917140.      1336592.       674565.      3928298.
3   20   89           318348.       660656.       356809.      1335812.
3   20   90           111892.       588341.       272884.       973118.
3   20   91           598735.       568394.       253780.      1420909.
3   20   92           328359.       304079.       127266.       759704.
3   20   93           314038.       368423.       191023.       873484.
3   20  999          3588509.      3826481.      1876325.      9291324.

3   21   94           343623.       687704.       373464.      1404791.
3   21   95                0.       402143.       196242.       598385.
3   21   96                0.       276124.       114032.       390156.
3   21   97            98644.       631133.       311128.      1040905.
3   21   98           393255.       727459.       382173.      1502848.
3   21   99                0.       31[illegible]40.  14[illegible].  [illegible].
3   21  100          178243.       47[illegible]1.  [illegible]71[illegible].  [illegible].
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S    C  AA            VMT - EXP     VMT - ART     VMT - LOC    VMT - TOTAL

3   13  61             663655.       631384.       283490.       1578529.      *      *
3   13  62             867378.       678760.       311558.       1857695.      *      *
3   13  63             151558.       151192.        75035.        377784.      *      *
3   13 999            1682589.      1461335.       670083.       3814008.      *      *

3   14  64            1174166.      1231629.       535277.       2941074.      *      *
3   14  65             557050.      1035859.       494015.       2086924.      *      *
3   14  66                  0.       773095.       346664.       1119758.      *      *
3   14  67              67405.       606184.       284061.        957649.      *      *
3   14 999            1798620.      3646764.      1660015.       7105405.      *      *

3   15  68            1430529.      1251123.       603861.       3285514.      *      *
3   15  69             592603.       604797.       381060.       1578460.      *      *
3   15  70             700885.      1502898.       788213.       2991997.      *      *
3   15  71             277152.       783513.       413389.       1474054.      *      *
3   15  72                  0.       632410.       285492.        917902.      *      *
3   15 999            3001168.      4774740.      2472013.      10247927.      *      *

3   16  73            1090024.      1059581.       599817.       2749423.      *      *
3   16  74                  0.       573587.       267822.        841409.      *      *
3   16  75                  1.       583226.       274795.        858022.      *      *
3   16 999            1090024.      2216393.      1142433.       4448853.      *      *

3   17  76             793954.       871824.       438937.       2104715.      *      *
3   17  77              95833.       788338.       381485.       1265655.      *      *
3   17  78             506159.       496351.       277729.       1280238.      *      *
3   17  79                  0.       508172.       241181.        749354.      *      *
3   17  80                  1.       474311.       222993.        697305.      *      *
3   17 999            1395945.      3138993.      1562321.       6097265.      *      *

3   18  81             431347.       778232.       358228.       1567807.      *      *
3   18  82             209459.       495744.       267510.        972713.      *      *
3   18  83             422749.      1206303.       606428.       2235481.      *      *
3   18  84             114936.       615930.       313415.       1044281.      *      *
3   18 999            1178490.      3096208.      1545580.       5820282.      *      *

3   19  85             568697.       606283.       305399.       1480380.      *      *
3   19  86             865215.       505663.       220539.       1591418.      *      *
3   19  87                  1.       950010.       439660.       1389671.      *      *
3   19 999            1433912.      2061956.       965598.       4461469.      *      *

3   20  88            1917140.      1336592.       674565.       3928298.      *      *
3   20  89             318348.       660656.       356809.       1335812.      *      *
3   20  90             111892.       588341.       272884.        973118.      *      *
3   20  91             598735.       568394.       253780.       1420909.      *      *
3   20  92             328359.       304079.       127266.        759704.      *      *
3   20  93             314038.       368423.       191023.        873484.      *      *
3   20 999            3588509.      3826481.      1876325.       9291324.      *      *

3   21  94             343623.       687704.       373464.       1404791.      *      *
3   21  95                  0.       402143.       196242.        598385.      *      *
3   21  96                  0.       276124.       114032.        390156.      *      *
3   21  97              98644.       631133.       311128.       1040905.      *      *
3   21  98             393255.       727459.       382173.    [illegible]      *      *
3   21  99                  0.   [illegible]   [illegible]    [illegible]      *      *
3   21 100         [illegible]   [illegible]   [illegible]    [illegible]
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                        1013768.     3782579.     [illegible]     [illegible]        *            *

S    C  AA              VMT - EXP    VMT - ART    VMT - LOC    VMT - TOTAL

3   22 102               706187.      472615.      269123.      1447925.          *            *
3   22 103                    0.      762187.      366516.      1128703.          *            *
3   22 104               423096.     1196795.      671036.      2290928.          *            *
3   22 999              1129283.     2431596.     1306674.      4867556.          *            *

3   99 999             17312304.    30437024.    15067070.     62816400.          *            *
```

S	C	AA	VMT - EXP	VMT - ART	VMT - LOC	VMT - TOTAL		
4	23	105	335171.	341773.	190997.	867941.	*	*
4	23	106	264187.	267716.	143899.	675802.	*	*
4	23	107	422936.	587335.	318019.	1328290.	*	*
4	23	108	0.	459105.	216402.	675507.	*	*
4	23	109	740676.	590987.	328491.	1660153.	*	*
4	23	999	1762969.	2246913.	1197807.	5207691.	*	*
4	24	110	128892.	452860.	231390.	813143.	*	*
4	24	111	333805.	283094.	170956.	787855.	*	*
4	24	112	617299.	914278.	497694.	2029271.	*	*
4	24	999	1079995.	1650231.	900041.	3630269.	*	*
4	25	113	193692.	448421.	229246.	871358.	*	*
4	25	999	193692.	448421.	229246.	871358.	*	*
4	26	114	660039.	536333.	294460.	1490832.	*	*
4	26	115	712724.	570753.	272881.	1556357.	*	*
4	26	116	352712.	505074.	263344.	1121130.	*	*
4	26	117	206154.	323116.	174666.	703936.	*	*
4	26	118	508200.	548798.	279310.	1336309.	*	*
4	26	119	49658.	169871.	83420.	302949.	*	*
4	26	120	826959.	462040.	246175.	1535175.	*	*
4	26	999	3316441.	3115982.	1614256.	8046687.	*	*
4	27	121	142911.	643785.	324200.	1110896.	*	*
4	27	122	748304.	1207563.	685301.	2641169.	*	*
4	27	123	199033.	346826.	208853.	754712.	*	*
4	27	999	1090247.	2198173.	1218353.	4506776.	*	*
4	28	124	32892.	399651.	202978.	635521.	*	*
4	28	125	163922.	206568.	127100.	497590.	*	*
4	28	126	302333.	500102.	286810.	1089245.	*	*
4	28	127	1.	533079.	253353.	786432.	*	*
4	28	999	499148.	1639398.	870239.	3008787.	*	*
4	99	999	7942490.	11299117.	6029940.	25271552.	*	*

```
S    C  AA                    VMT - EXP     VMT - ART     VMT - LOC    VMT - TOTAL

 9  99 999                    57137648.     83287856.     41924848.    182350448.          *          *
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ECONOMIC EVALUATION OF HIGHWAY NETWORK

HIGHWAY EVALUATION FOR THE YEAR 1970  BASED ON FIXED SUPPLY  1  USING PROJECTION 1

TIME VALUED AT 2.50 DOLLARS PER HOUR.
BASED ON INTEREST RATE OF 10 PERCENT AND ECONOMIC LIFE OF 25 YEARS.

CONST. COST FACTOR IS  1.300


EXP ACC COST IS  1470. ART ACC COST IS  1250.
RELOCATION COST IS  10000. PER HH.   VEHOP COST FACTOR IS   1.00


 ADJUSTMENTS    SPDEXP  SPDART  SPDLOC  ACCEXP  ACCAL
                 1.00    1.00    1.00    1.00    1.00               MAINT COST PER MILE IS     33000.


 VMT EQUATION    VMT=    0. + 64.3 *VTE**0.74 *2.718**( 1.6 *FE/FO


    FIELD   0 NOT IN RANGE


    FIELD   0 NOT IN RANGE
```

```
S    C  AA                EXPWY SPEED   ARTERL SPEED   LOCAL SPEED      SPEED

1    1   1                   35.67         10.25          5.04          12.94       .        .
1    1   2                   35.87         12.90          7.02          15.00       .        .
1    1   3                   42.04         16.45          8.29          21.93       .        .
1    1 999                   37.14         11.75          5.96          14.76       .        .

1    2   4                   39.56         15.70          8.76          18.41       .        .
1    2   5                   44.28         19.67         11.24          26.61       .        .
1    2   6                   41.38         18.25         10.76          21.25       .        .
1    2   7                   44.22         20.50         11.69          23.73       .        .
1    2 999                   41.71         17.36         10.00          21.00       .        .

1    3   8                   38.70         15.34          8.91          16.09       .        .
1    3   9                   39.03         15.34          9.61          13.02       .        .
1    3  10                   41.92         17.51          9.52          18.36       .        .
1    3  11                   41.86         18.23         10.23          18.09       .        .
1    3 999                   40.57         16.49          9.52          16.56       .        .

1    4  12                   48.60         24.44         13.37          32.15       .        .
1    4  13                   39.85         16.22          9.78          18.68 .     .        .
1    4  14                   42.08         18.15         10.74          20.47       .        .
1    4  15                   41.19         17.91         10.81          19.61       .        .
1    4 999                   41.45         17.48         10.49          19.88       .        .

1    5  16                   46.98         24.74         13.97          24.77       .        .
1    5  17                   45.64         21.20         12.33          17.64       .        .
1    5  18                   48.20         25.13         15.16          21.11       .        .
1    5 999                   46.84         22.93         13.38          20.09       .        .

1   99 999                   40.56         16.12          9.66          18.17       .        .
```

```
S   C  AA        EXPWY SPEED   ARTERL SPEED   LOCAL SPEED      SPEED

2   6  19           43.91         20.32         12.46         18.51        *        *
2   6  20           42.08         18.42         11.01         18.71        *        *
2   6  21           44.05         18.77         11.50         17.16        *        *
2   6  22           46.48         25.66         15.13         25.08        *        *
2   6  23           44.19         19.81         11.24         20.01        *        *
2   6  24           46.81         22.54         12.43         24.03        *        *
2   6 999           44.38         20.07         11.83         19.62        *        *

2   7  25           48.41         24.88         13.90         23.65        *        *
2   7  26           45.84         21.50         12.89         20.83        *        *
2   7  27           48.09         24.51         14.09         25.98        *        *
2   7  28           48.08         25.31         15.13         23.30        *        *
2   7  29           48.51         25.99         15.06         25.20        *        *
2   7  30           52.54         30.32         17.92         37.14        *        *
2   7  31           50.78         29.89         17.45         28.41        *        *
2   7  32           51.34         31.22         18.78         26.25        *        *
2   7  33           53.43         32.37         18.80         32.43        *        *
2   7  34           52.36         32.46         19.58         26.96        *        *
2   7 999           48.62         26.30         15.26         25.00        *        *

2   8  35           44.31         19.68         11.08         21.75        *        *
2   8  36           45.40         21.20         11.85         24.71        *        *
2   8  37           46.72         23.48         13.17         26.23        *        *
2   8  38           53.86         33.68         20.60         28.01        *        *
2   8  39           48.40         25.98         14.97         27.94        *        *
2   8  40           51.67         30.47         18.18         29.57        *        *
2   8  41           50.12         28.23         16.53         29.25        *        *
2   8  42           53.70         33.22         19.83         31.70        *        *
2   8 999           46.87         24.16         13.70         25.92        *        *

2   9  43           48.42         26.32         14.96         28.64        *        *
2   9  44           49.25         27.05         15.37         28.18        *        *
2   9  45           48.87         28.36         16.26         26.98        *        *
2   9  46           53.54         33.12         19.61         33.89        *        *
2   9 999           49.63         27.75         15.97         29.07        *        *

2  10  47           53.90         33.79         20.54         31.30        *        *
2  10  48           55.14         35.10         20.80         34.58        *        *
2  10 999           54.58         34.29         20.64         32.68        *        *

2  11  49           52.07         30.61         18.25         30.94        *        *
2  11  50           53.28         33.05         20.33         29.13        *        *
2  11  51           48.74         26.05         16.02         24.13        *        *
2  11  52           55.36         35.54         21.98         31.11        *        *
2  11  53           52.85         31.83         19.56         28.10        *        *
2  11  54           57.27         38.47         23.45         36.09        *        *
2  11 999           51.99         30.60         18.72         28.15        *        *

2  12  55           53.36         33.22         20.26         28.64        *        *
2  12  56           53.80         33.60         19.80         33.82        *        *
2  12  57           54.90         34.60         21.01         31.64        *        *
2  12  58           52.60         31.70         19.30         28.26        *        *
2  12  59           50.77         30.00         18.19         26.42        *        *
2  12  60           50.51         29.21         17.55         27.09        *        *
2  12 999           52.58         31.52         19.03         29.18        *        *
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```
S   C  AA                    EXPWY SPEED   ARTERL SPEED   LOCAL SPEED        SPEED

 2  99 999                      47.81         25.00          14.67           24.44
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S    C  AA          EXPWY SPEED   ARTERL SPEED   LOCAL SPEED    SPEED

3   13   61           41.34         18.45          10.90         20.69        *        *
3   13   62           41.94         18.47          10.78         21.52        *        *
3   13   63           44.19         20.04          10.82         21.09        *        *
3   13  999           41.89         18.61          10.83         21.12        *        *

3   14   64           39.24         16.22           9.59         18.19        *        *
3   14   65           42.53         19.07          10.84         18.47        *        *
3   14   66           44.69         22.93          14.13         19.22        *        *
3   14   67           44.79         21.59          12.64         18.40        *        *
3   14  999           40.40         16.99          11.19         18.46        *        *

3   15   68           42.17         18.75          10.82         21.00        *        *
3   15   69           44.91         19.81          11.26         20.35        *        *
3   15   70           42.53         18.27          11.09         17.62        *        *
3   15   71           46.78         23.26          13.82         21.20        *        *
3   15   72           47.73         26.12          15.68         21.64        *        *
3   15  999           43.17         20.11          11.84         19.87        *        *

3   16   73           43.07         18.35          10.39         19.53        *        *
3   16   74           45.22         21.66          13.40         18.11        *        *
3   16   75           52.18         31.30          19.34         26.13        *        *
3   16  999           43.07         21.55          12.43         20.21        *        *

3   17   76           47.75         25.87          15.23         26.59        *        *
3   17   77           47.90         25.44          15.33         21.87        *        *
3   17   78           49.74         27.51          15.89         28.02        *        *
3   17   79           51.86         30.69          19.07         25.66        *        *
3   17   80           53.39         33.07          20.37         27.57        *        *
3   17  999           48.46         27.62          16.48         25.70        *        *

3   18   81           41.38         18.52          10.81         18.32        *        *
3   18   82           43.23         18.87          11.91         18.16        *        *
3   18   83           43.14         19.78          12.23         18.57        *        *
3   18   84           44.25         19.64          12.07         17.42        *        *
3   18  999           42.59         19.28          11.78         18.22        *        *

3   19   85           47.95         25.98          15.17         26.76        *        *
3   19   86           50.84         29.45          16.97         33.73        *        *
3   19   87           49.31         28.14          17.62         23.67        *        *
3   19  999           49.65         27.76          16.62         27.67        *        *

3   20   88           44.82         21.95          12.84         25.15        *        *
3   20   89           47.21         24.06          14.33         22.60        *        *
3   20   90           46.47         25.21          15.31         22.34        *        *
3   20   91           46.00         23.96          13.87         25.82        *        *
3   20   92           52.19         31.33          17.95         32.90        *        *
3   20   93           49.89         28.60          16.97         28.71        *        *
3   20  999           46.29         24.22          14.23         25.29        *        *

3   21   94           47.46         24.50          14.67         23.12        *        *
3   21   95           48.34         24.42          15.06         20.29        *        *
3   21   96           52.61         34.71          21.10         29.20        *        *
3   21   97           47.00         23.37          13.53         19.98        *        *
3   21   98           48.44         25.67          14.74         24.09        *        *
3   21   99           51.59         31.18          18.74         25.93        *        *
3   [illegible]       52.89         32.61          19.11         [illegible]  *        *
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 3  1 [illegible]        48.67       26.90        15.[illegible]       25.83         *           *

 S    C  AA          EXPWY SPEED  ARTERL SPEED  LOCAL SPEED        SPEED

 3  22 102               49.53        27.33        15.89          29.86         *           *
 3  22 103               48.01        25.07        16.33          21.36         *           *
 3  22 104               46.19        22.14        14.14          20.70         *           *
 3  22 999               48.22        23.90        15.05          22.96         *           *

 3  99 999               44.75        22.39        13.31          21.82         *           *
```

```
S   C  AA          EXPWY SPEED   ARTERL SPEED   LOCAL SPEED      SPEED

4  23 105             45.04          21.60          12.78         22.72       *       *
4  23 106             50.63          29.63          17.77         30.23       *       *
4  23 107             43.89          20.00          11.79         20.14       *       *
4  23 108             50.44          28.85          17.93         24.14       *       *
4  23 109             46.38          23.20          13.42         25.18       *       *
4  23 999             46.07          23.50          13.84         23.63       *       *

4  24 110             50.12          28.54          17.29         25.55       *       *
4  24 111             47.36          23.99          13.84         25.25       *       *
4  24 112             43.46          19.38          11.54         19.42       *       *
4  24 999             45.33          22.05          13.07         21.67       *       *

4  25 113             48.37          26.26          15.58         24.34       *       *
4  25 999             48.37          26.26          15.58         24.34       *       *

4  26 114             46.96          24.28          14.24         26.24       *       *
4  26 115             43.68          20.34          11.47         22.84       *       *
4  26 116             47.38          25.22          15.00         24.90       *       *
4  26 117             49.94          28.60          17.32         27.59       *       *
4  26 118             49.60          28.25          16.68         28.79       *       *
4  26 119             53.78          34.66          21.34         31.12       *       *
4  26 120             48.34          25.65          14.75         29.63       *       *
4  26 999             47.23          25.17          14.75         26.52       *       *

4  27 121             50.13          29.11          18.21         25.98       *       *
4  27 122             48.01          25.22          15.24         24.36       *       *
4  27 123             52.60          31.16          18.84         29.03       *       *
4  27 999             49.06          27.10          16.49         25.43       *       *

4  28 124             52.16          30.56          19.10         26.11       *       *
4  28 125             52.98          32.02          19.33         30.87       *       *
4  28 126             49.84          27.65          16.69         26.35       *       *
4  28 127             51.96          31.02          19.56         26.09       *       *
4  28 999             50.98          29.91          18.38         26.88       *       *

4  99 999             47.18          25.26          15.05         24.86       *       *
```

```
S    C  AA                 EXPWY SPEED   ARTERL SPEED    LOCAL SPEED        SPEED

 9  99 999                      44.95          22.02          13.22          22.17
```

APPENDIX C

DATA DOCUMENTATION LIST

BIBLIOGRAPHY

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3. New York State Department of Environmental Conservation, New York City Metropolitan Area Air Quality Implementation Plan, Revised May 1972, 195 pgs.

4. New York State Department of Environmental Conservation, Motor Vehicle Emissions Control: A Plan for Action, November 30, 1971, 114 pgs.

5. New York State Department of Environmental Conservation, The Economic and Technological Feasibility of Requiring Air Contaminant Emission Control Systems on Used Motor Vehicles, A Report to the Legislature, February 1, 1972, 45 pgs.

6. Tri-State Transportation Commission, Streets and Highways: A Regional Report, January 1968, 44 pgs.

7. Tri-State Regional Planning Commission, Regional Profile Subway Riders and Manhattan Autos, October 1971, Vol. 1 No. 14, 8 pgs. - 2 cps.

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9. Tri-State Transportation Commission, Regional Development Guide: Technical Perspectives, November 1969, 54 pgs.

10. Tri-State Transportation Commission, Tri-State Transportation 1985: An Interim Plan, May 1966, 39 pgs.

11. Tri-State Regional Planning Commission, Interim Technical Report, 4305-1205 Motor Vehicle Registrations 1971, June 1972, 13 pgs.

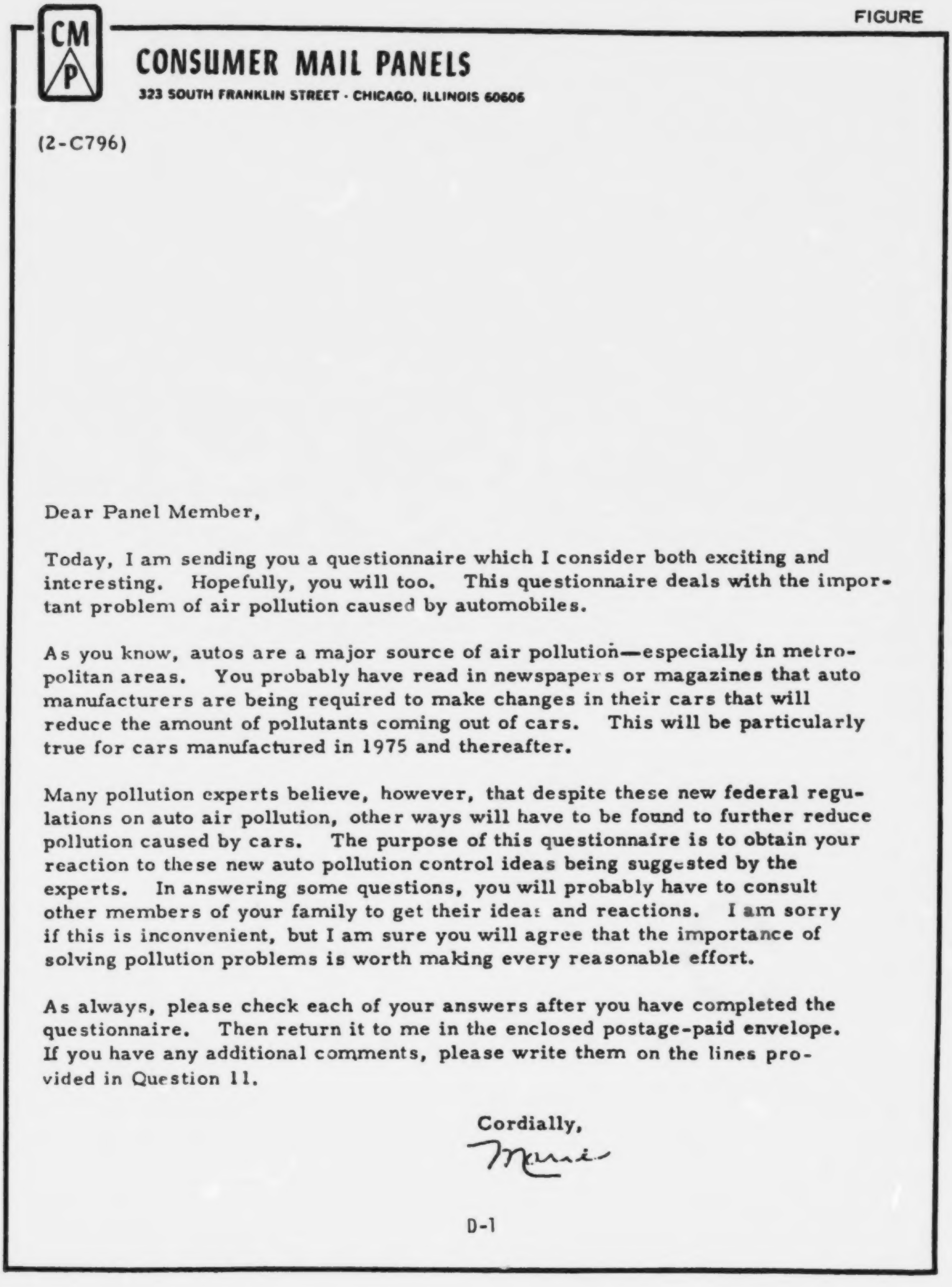
12. Tri-State Regional Planning Commission, Interim Technical Report, 4324-1205, Vehicular River Crossings: 1971 (within the Tri-State Region), August 1972, 13 pgs.

13. TRW Inc., Prediction of the Effects of Transportation Controls on Air Quality in Major Metropolitan Areas, Report to Federal Environmental Protection Agency, November 20, 1972.

14. D.S. Kircher and D.P. Armstrong, An Interim Report on Motor Vehicle Emission Estimation, Draft Report, Environmental Protection Agency, October 1972.

APPENDIX D
AUTOMOBILE AIR POLLUTION QUESTIONNAIRE

FIGURE



CM P
CONSUMER MAIL PANELS
323 SOUTH FRANKLIN STREET · CHICAGO, ILLINOIS 60606

(2-C796)

Dear Panel Member,

Today, I am sending you a questionnaire which I consider both exciting and interesting. Hopefully, you will too. This questionnaire deals with the important problem of air pollution caused by automobiles.

As you know, autos are a major source of air pollution—especially in metropolitan areas. You probably have read in newspapers or magazines that auto manufacturers are being required to make changes in their cars that will reduce the amount of pollutants coming out of cars. This will be particularly true for cars manufactured in 1975 and thereafter.

Many pollution experts believe, however, that despite these new federal regulations on auto air pollution, other ways will have to be found to further reduce pollution caused by cars. The purpose of this questionnaire is to obtain your reaction to these new auto pollution control ideas being suggested by the experts. In answering some questions, you will probably have to consult other members of your family to get their ideas and reactions. I am sorry if this is inconvenient, but I am sure you will agree that the importance of solving pollution problems is worth making every reasonable effort.

As always, please check each of your answers after you have completed the questionnaire. Then return it to me in the enclosed postage-paid envelope. If you have any additional comments, please write them on the lines provided in Question 11.

Cordially,

CONSUMER MAIL PANELS
[illegible]

(2-C796)

AUTO AIR POLLUTION QUESTIONNAIRE

☐ 13

14-16 Open

1. All autos made in 1975 and thereafter will be equipped with emmision control devices to reduce air pollution. If in 1975 you owned a car built before that year, how would you feel about a law requiring you to put emission control equipment which might cost $200 on your car? ("X" BELOW)

2. How would you feel about this law if the cost was reduced by government subsidy to about $50? ("X" BELOW)

Feeling Toward Law:	1. Cost $200	2. Cost $50
Very much in favor of law . .	☐1	☐1
Somewhat in favor of law . . .	☐2 (17)	☐2 (18)
Somewhat against law	☐3	☐3
Very much against law	☐4	☐4

3a. Even cars properly equipped with emmision control equipment might still pollute the air if the equipment was not properly maintained. How would you feel about a law requiring periodic inspection of the emission control system to assure that it was working properly? ("X" ONE ONLY)

Very much in favor of law ☐1 Somewhat in favor of law ☐2 Somewhat against law ☐3 Very much against law ☐4 — 19

3b. Assuming you had to have your car inspected at least once a year, what would you consider a reasonable cost for the inspection? (WRITE IN AMOUNT)

$________________ 20 ☐☐ 21

3c. Assuming you had to have your car inspected at least once a year, where do you think the inspection should be made? ("X" ONE ONLY)

At state-operated inspection centers . ☐1
At city-operated inspection centers. . ☐2
At local service stations or garages . ☐3
At some other place (Specify): ____________________ ☐4 — 22
____

4a. Even if all autos were equipped with properly maintained emission control systems, some cities might still have auto air pollution problems due to the large number of cars either on the streets at the same time or concentrated in particular areas. Listed below are several possible ways to reduce pollution under one or both of these conditions. Please tell me how you feel about each of these proposals. ("X" ONE ON EACH LINE)

	To Me This Plan Is:					
Proposal:	Very Acceptable	Somewhat Acceptable	Neither Acceptable Nor Unacceptable	Somewhat Unacceptable	Very Unacceptable	
a. Gasoline rationing	☐1	☐2	☐3	☐4	☐5	23
b. Very high ($500) registration fee per auto.	☐1	☐2	☐3	☐4	☐5	24
c. Very high ($500) registration fee per auto but only for the second, third, etc., auto.	☐1	☐2	☐3	☐4	☐5	25
d. Prohibit traffic and parking in central business districts	☐1	☐2	☐3	☐4	☐5	26
e. A tax on all day parking in central business districts . .	☐1	☐2	☐3	☐4	☐5	27
f. A tax on parking in central business districts regardless of whether a person parked only one hour or all day	☐1	☐2	☐3	☐4	☐5	28
g. Tolls on exit ramps of major freeways and expressways	☐1	☐2	☐3	☐4	☐5	29
h. Tolls on exit ramps of major freeways and expressways but only when traffic was heavy.	☐1	☐2	☐3	☐4	☐5	30
i. Restrictions on non-essential auto travel during times of high pollution by issuance of special license plates or vehicle stickers	☐1	☐2	☐3	☐4	☐5	31
j. Turn some existing lanes into "bus only" and "car pool only" lanes on major expressways and streets	☐1	☐2	☐3	☐4	☐5	32

4b. Which of the proposals listed above would be the most acceptable? (Give Letter)______ ☐ 33

4c. Which would be most unacceptable? . . . . (Give Letter)______ ☐ 34

Page 2 (2-C796)

QUESTIONS 5-8 ASK FOR INFORMATION RELATING TO OTHER HOUSEHOLD MEMBERS. CONSULT THEM, IF NECESSARY, FOR THE ANSWERS.

5a. How often do the various members of your household travel by public transportation? (For example, by bus, subway, or commuter train.)

	Husband		Wife		Children (Over 16 Years Old)	
Three or more times a week	☐1		☐1		☐1	
One or two times a week	☐2		☐2		☐2	
Once a month	☐3	(35)	☐3	(36)	☐3	(37)
Once every three months	☐4		☐4		☐4	
Never	☐5		☐5		☐5	
No household member	☐6		☐6		☐6	

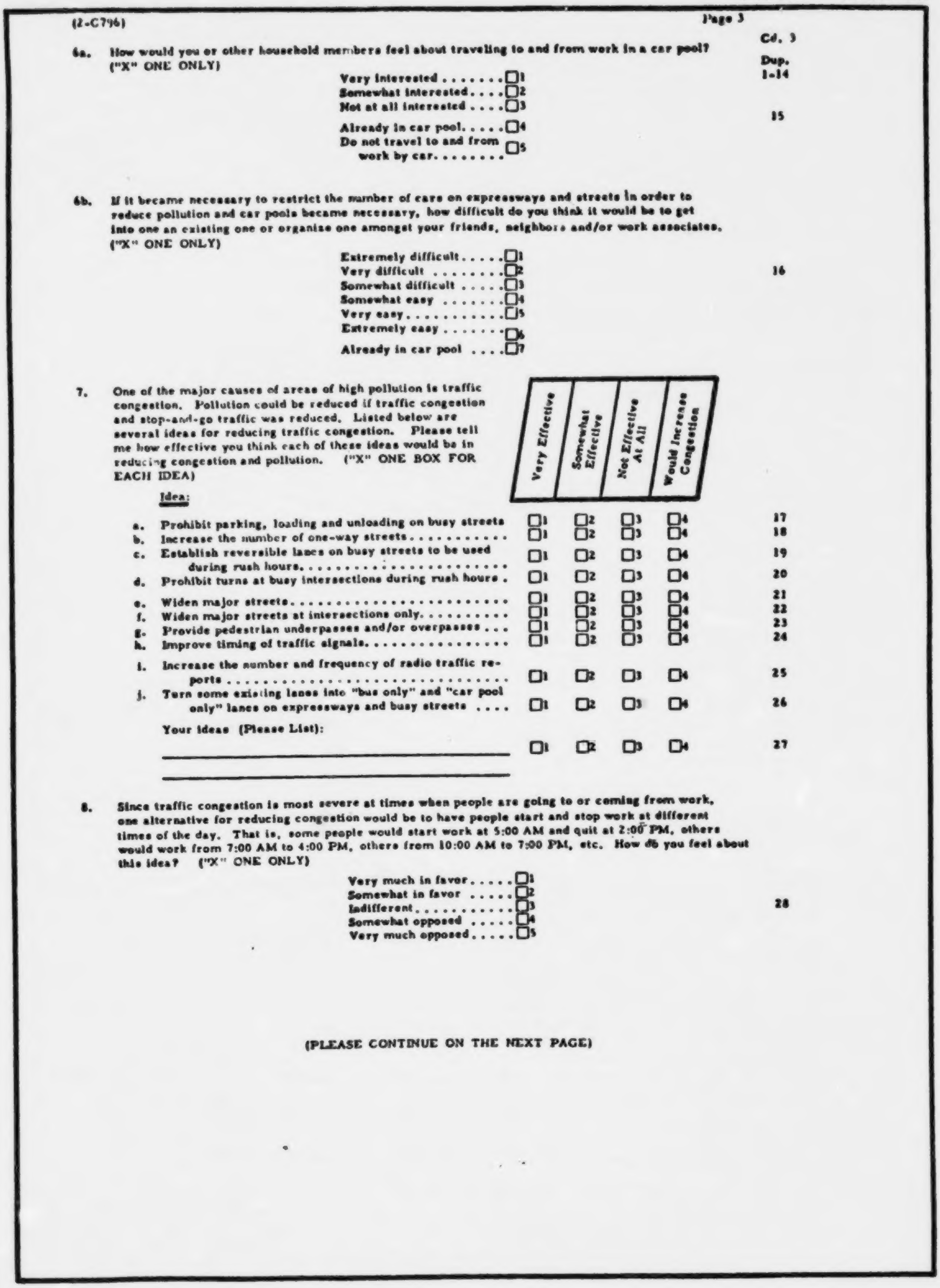
5b. Please rate each household member' reason for using public transportation. (Rate the most important reason "1", the next most important "2", the next "3", etc. If a household member never uses public transportation, "X" the "never use" box at the bottom of the list.)

5c. Please rate each household member's reasons for traveling by auto. Follow the same procedure as in Question 5b. (WRITE IN BELOW UNDER 5c)

	5b. Public Transportation			5c. Auto Transportation			
Reasons:	Husband	Wife	Children (Over 16 Years Old)	Husband	Wife	Children (Over 16 Years Old)	
a. Cheaper	____(38)	____(39)	____(40)	____(41)	____(42)	____(43)	
b. Faster	____(44)	____(45)	____(46)	____(47)	____(48)	____(49)	
c. More comfortable	____(50)	____(51)	____(52)	____(53)	____(54)	____(55)	
d. Safer for passenger	____(56)	____(57)	____(58)	____(59)	____(60)	____(61)	(74-78
e. Less congested	____(62)	____(63)	____(64)	____(65)	____(66)	____(67)	open)
f. More available	____(68)	____(69)	____(70)	____(71)	____(72)	____(73)	79 -1 80 Cd. 2
g. More flexible (I can come and go as I please)	____(15)	____(16)	____(17)	____(18)	____(19)	____(20)	Dup. 1-14
h. More relaxing (able to read while traveling)	____(21)	____(22)	____(23)	----- (Not Applicable) -----			
i. Need car during the day	----- (Not Applicable) -----			____(24)	____(25)	____(26)	
j. I do not have a driver's license	____(27)	____(28)	____(29)	----- (Not Applicable) -----			
k. Car is not available when I need it	____(30)	____(31)	____(32)	----- (Not Applicable) -----			
l. Other (Specify): ____________	____(33)	____(34)	____(35)	____(36)	____(37)	____(38)	
m. Never use ("X" Box)	☐1	☐2	☐3 (39)	☐1	☐2	☐3 (40)	

5d. Again, consulting other members of your household, please rate in order of effectiveness which items below you feel would be most effective in encouraging the use of public transporation: (Rate the most effective item a "1", the next most effective "2", the next "3", etc.)

Items:	Husband	Wife	Children (Over 16 Years Old)	
Cleaner and newer vehicles	____ (41)	____ (42)	____ (43)	
Faster travel	____ (44)	____ (45)	____ (46)	
Air-conditioned vehicles	____ (47)	____ (48)	____ (49)	
More frequent service	____ (50)	____ (51)	____ (52)	
Lower fares	____ (53)	____ (54)	____ (55)	
Parking facilities at stops or stations	____ (56)	____ (57)	____ (58)	
Shelters against bad weather at stops or stations	____ (59)	____ (60)	____ (61)	
Better security to assure personal safety	____ (62)	____ (63)	____ (64)	
More conveniently located stops or stations	____ (65)	____ (66)	____ (67)	(71-78 open)
Other (Specify): ____________	____ (68)	____ (69)	____ (70)	79 -2 80



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Page 3

Cd. 3

Dup. 1-14

6a. How would you or other household members feel about traveling to and from work in a car pool? ("X" ONE ONLY)

Very interested .... ☐1
Somewhat interested.... ☐2
Not at all interested .... ☐3
Already in car pool..... ☐4
Do not travel to and from work by car........ ☐5

15

6b. If it became necessary to restrict the number of cars on expressways and streets in order to reduce pollution and car pools became necessary, how difficult do you think it would be to get into one an existing one or organize one amongst your friends, neighbors and/or work associates. ("X" ONE ONLY)

Extremely difficult..... ☐1
Very difficult .... ☐2
Somewhat difficult ..... ☐3
Somewhat easy .... ☐4
Very easy........... ☐5
Extremely easy .... ☐6
Already in car pool .... ☐7

16

7. One of the major causes of areas of high pollution is traffic congestion. Pollution could be reduced if traffic congestion and stop-and-go traffic was reduced. Listed below are several ideas for reducing traffic congestion. Please tell me how effective you think each of these ideas would be in reducing congestion and pollution. ("X" ONE BOX FOR EACH IDEA)

	Idea:	Very Effective	Somewhat Effective	Not Effective At All	Would Increase Congestion	
a.	Prohibit parking, loading and unloading on busy streets	☐1	☐2	☐3	☐4	17
b.	Increase the number of one-way streets...........	☐1	☐2	☐3	☐4	18
c.	Establish reversible lanes on busy streets to be used during rush hours......................	☐1	☐2	☐3	☐4	19
d.	Prohibit turns at busy intersections during rush hours .	☐1	☐2	☐3	☐4	20
e.	Widen major streets.......................	☐1	☐2	☐3	☐4	21
f.	Widen major streets at intersections only..........	☐1	☐2	☐3	☐4	22
g.	Provide pedestrian underpasses and/or overpasses ...	☐1	☐2	☐3	☐4	23
h.	Improve timing of traffic signals................	☐1	☐2	☐3	☐4	24
i.	Increase the number and frequency of radio traffic reports	☐1	☐2	☐3	☐4	25
j.	Turn some existing lanes into "bus only" and "car pool only" lanes on expressways and busy streets	☐1	☐2	☐3	☐4	26
	Your ideas (Please List): ____________________ ____________________	☐1	☐2	☐3	☐4	27

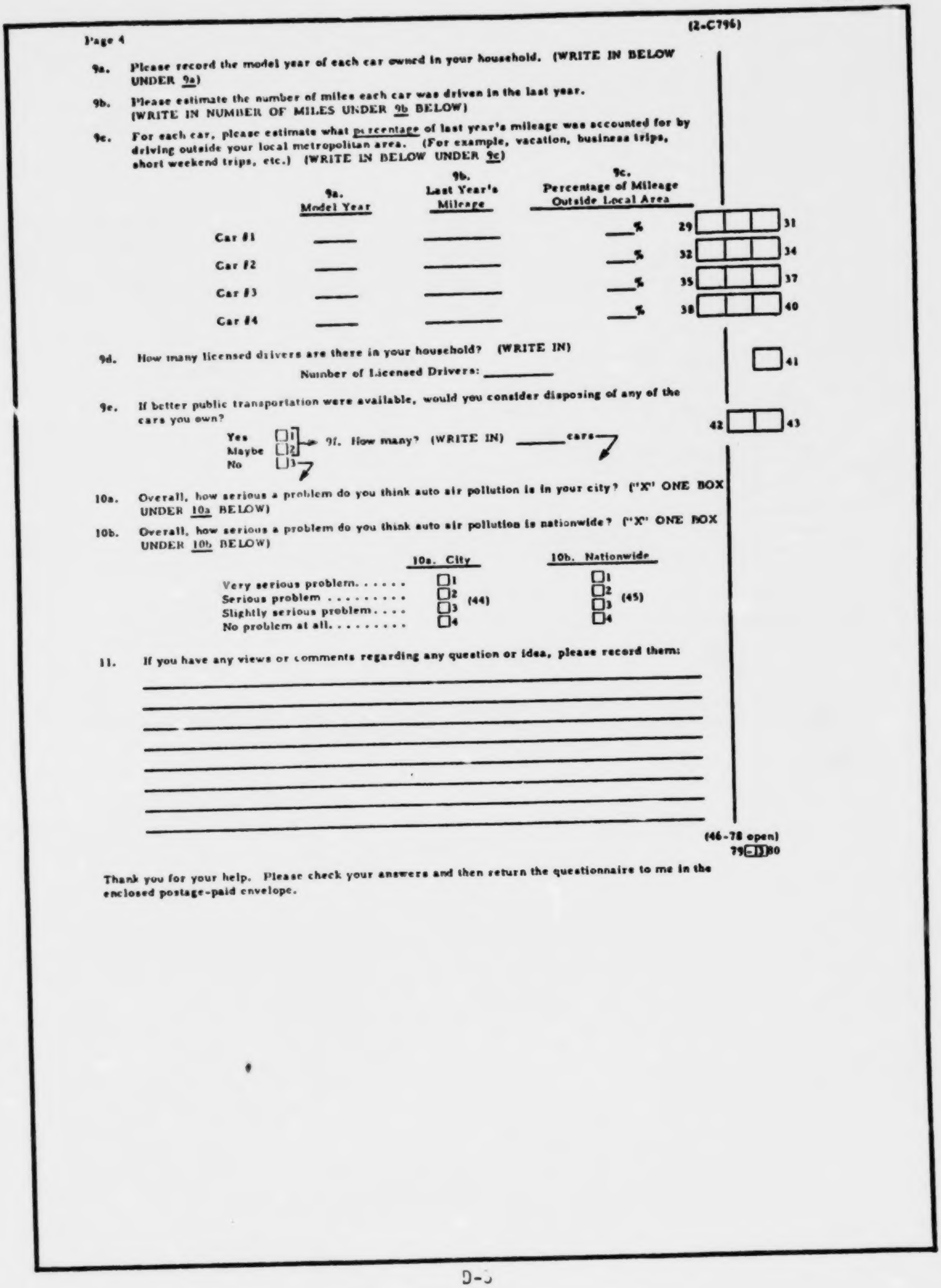
8. Since traffic congestion is most severe at times when people are going to or coming from work, one alternative for reducing congestion would be to have people start and stop work at different times of the day. That is, some people would start work at 5:00 AM and quit at 2:00 PM, others would work from 7:00 AM to 4:00 PM, others from 10:00 AM to 7:00 PM, etc. How do you feel about this idea? ("X" ONE ONLY)

Very much in favor..... ☐1
Somewhat in favor ..... ☐2
Indifferent............ ☐3
Somewhat opposed ..... ☐4
Very much opposed..... ☐5

28

(PLEASE CONTINUE ON THE NEXT PAGE)

FIGURE



Page 4

(2-C796)

9a. Please record the model year of each car owned in your household. (WRITE IN BELOW UNDER 9a)

9b. Please estimate the number of miles each car was driven in the last year. (WRITE IN NUMBER OF MILES UNDER 9b BELOW)

9c. For each car, please estimate what percentage of last year's mileage was accounted for by driving outside your local metropolitan area. (For example, vacation, business trips, short weekend trips, etc.) (WRITE IN BELOW UNDER 9c)

	9a. Model Year	9b. Last Year's Mileage	9c. Percentage of Mileage Outside Local Area	
Car #1	____	________	___%	29 ☐☐☐ 31
Car #2	____	________	___%	32 ☐☐☐ 34
Car #3	____	________	___%	35 ☐☐☐ 37
Car #4	____	________	___%	38 ☐☐☐ 40

9d. How many licensed drivers are there in your household? (WRITE IN)

Number of Licensed Drivers: ________

☐ 41

9e. If better public transportation were available, would you consider disposing of any of the cars you own?

Yes ☐1
Maybe ☐2 → 9f. How many? (WRITE IN) ______ cars
No ☐3

42 ☐☐ 43

10a. Overall, how serious a problem do you think auto air pollution is in your city? ("X" ONE BOX UNDER 10a BELOW)

10b. Overall, how serious a problem do you think auto air pollution is nationwide? ("X" ONE BOX UNDER 10b BELOW)

	10a. City	10b. Nationwide
Very serious problem.	☐1	☐1
Serious problem	☐2 (44)	☐2 (45)
Slightly serious problem. . . .	☐3	☐3
No problem at all.	☐4	☐4

11. If you have any views or comments regarding any question or idea, please record them:

____
____
____
____
____
____
____
____

(46-78 open)
79 ☐ 80

Thank you for your help. Please check your answers and then return the questionnaire to me in the enclosed postage-paid envelope.

1. All autos made in 1975 and thereafter will be equipped with emmision control devices to reduce air pollution. If in 1975 you owned a car built before that year, how would you feel about a law requiring you to put emission control equipment which might cost $200 on your car? ("X" BELOW)

2. How would you feel about this law if the cost was reduced by government subsidy to about $50? ("X" BELOW)

	(130 R)	(160 R)
Feeling Toward Law:	1. Cost $200	2. Cost $50
Very much in favor of law..	13.8%	64.4%
Somewhat in favor of law...	28.5	19.4
Somewhat against law......	19.2	8.1
Very much against law.....	38.5	8.1

3a. Even cars properly equipped with emmision control equipment might still pollute the air if the equipment was not properly maintained. How would you feel about a law requiring periodic inspection of the emission control system to assure that it was working properly? ("X" ONE ONLY)

Very much in favor of law	Somewhat in favor of law	Somewhat against.law	Very much against law
72.0%	19.5%	3.7%	4.8%

3b. Assuming you had to have your car inspected at least once a year, what would you consider a reasonable cost for the inspection? (WRITE IN AMOUNT)

$ 7.80 (mean)

3c. Assuming you had to have your car inspected at least once a year, where do you think the inspection should be made? ("X" ONE ONLY)

	(162 R)
At state-operated inspection centers.....	45.1%
At city-operated inspection centers......	9.9
At local service stations or garages.....	39.5
At some other place (Specify):	5.5

Some respondents thought the federal government should be involved in vehicle inspection. Several thought a form of licensed inspection centers or garages could provide this service.

4a. **Even if all autos were equipped with properly maintained emission control systems, some cities might still have auto air pollution problems due to the large number of cars either on the streets at the same time or concentrated in particular areas. Listed below are several possible ways to reduce pollution under one or both of these conditions. Please tell me how you feel about each of these proposals. ("X" ONE ON EACH LINE)**

To Me This Plan Is:

+2 +1 0 0 -1 -2

Proposal	Very Acceptable	Somewhat Acceptable	Neither Acceptable Nor Unacceptable	Somewhat Unacceptable	Very Unacceptable
a. Gasonline rationing	3.2	2.5	5.1	11.4	▲ 77.8
b. Very high ($500) registration fee per auto	1.3	4.4	4.4	7.6	▲ 82.3
c. Very high ($500) registration fee per auto but only for the second, third, etc., auto	7.7	11.5	6.4	14.8 ▲	59.6
d. Prohibit traffic and parking in central business districts	36.7	▲ 29.1	7.0	15.2	12.0
e. A tax on all day parking in central business districts	25.8	▲ 25.9	13.8	11.9	22.6
f. A tax on parking in central business districts regardless of whether a person parked only one hour or all day	15.1	25.0	9.9	▲ 13.2	36.8
g. Tolls on exit ramps of major freeways and expressways	5.7	10.8	7.6	10.9	▲ 65.0
h. Tolls on exit ramps of major freeways and expressways but only when traffic was heavy	7.7	9.7	7.1	12.9 ▲	62.6
i. Restrictions on non-essential auto travel during times of high pollution by issuance of special license plates or vehicle stickers	22.2	19.6	6.3	▲ 15.8	36.1
j. Turn some existing lanes into "bus only" and "car pool only" lanes on major expressways and streets	46.8	▲ 23.1	6.9	9.4	13.8

▲ Indicates the weighted mean for each answer.

4b. Which of the proposals listed above would be the most acceptable? (Give Letter:) j - 41.1%
d - 35.8%

4c. Which would be most unacceptable? .... (Give Letter:) b - 49.7%
a - 38.7%

QUESTIONS 5-8 ASK FOR INFORMATION RELATING TO OTHER HOUSEHOLD MEMBERS. CONSULT THEM, IF NECESSARY, FOR THE ANSWERS.

5a. How often do the various members of your household travel by public transportation? (For example, by bus, subway, or commuter train.)

	(141 R) Husband	(163 R) Wife	(95 R) Children (Over 16 Years Old)
Three or more times a week.	29.8%	24.5%	24.2%
One or two times a week.....	6.4	9.7	6.3
Once a month...............	3.4	15.7	2.1
Once every three months	14.2	12.8	5.3
Never	39.7	37.3	21.1
No household member	6.5	- -	41.0

5b. Please rate each household member's reason for using public transportation. (Rate the most important reason "1", the next most important "2", the next "3", etc. If a household member never uses public transportation, "X" the "never use" box at the bottom of the list.) See attached

5c. Please rate each household member's reasons for traveling by auto. Follow the same procedure as in Question 5b. (WRITE IN BELOW UNDER 5c) See attached

		5b. Public Transportation			5c. Auto Transportation		
	Reasons	(132 R) Husband	(163 R) Wife	(56 R) Children (Over 16 Years Old)	(132 R) Husband	(163 R) Wife	(56 R) Children (Over 16 Years Old)
a.	Cheaper	9	9	7	4	2	2
b.	Faster	10	10	6	8	6	7
c.	More comfortable	3	1	2	5	5	5
d.	Safer for passenger.	2	3	3	1	1	1
e.	Less congested.	6	4	1	2	3	3
f.	More available	8	8	9	7	8	6
g.	More flexible (I can come and go as I please).	5	6	5	6	7	8
h.	More relaxing (able to read while traveling).	7	2	3	- - - NOT APPLICABLE - - -		
i.	Need car during the day.	- - - NOT APPLICABLE - - -			3	4	4
j.	I do not have a driver's license	1	5	9	- - - NOT APPLICABLE - - -		
k.	Car is not available when I need it	4	7	7	- - - NOT APPLICABLE - - -		
l.	Other (Specify): ____________						
m.	Never use ("X" Box)	56/132	61/163	24/56	91/132	26/163	12/56

5b Among the various "other" reasons for use of public transportation three additional items stood out:

1. Convenience
2. Non-availability and cost of parking
3. Many respondents not owning a car.

5c The only other reason stated for using the private auto was that many places are not accessible via public transportation.

5d. Again, consulting other members of your household, please rate in order of effectiveness which items below you feel would be most effective in encouraging the use of public transporation. (Rate the most effective item a "1", the next most effective "2", the next "3", etc.)

Ranking of individual opinions

Items:	Husband	Wife	Children (Over 16 Years Old)
Cleaner and newer vehicles	7	8	6
Faster travel	8	6	8
Air-conditioned vehicles	4	3	4
More frequent service	9	7	9
Lower fares	6	6	6
Parking facilities at stops or stations	2	1	2
Shelters against bad weather at stops or stations	1	2	3
Better security to assure personal safety	3	5	5
More conveniently located stops and stations	5	3	1
Other (Specify):			

Various suggestions for improving the amenity level of public transportation were put forward, but the only agreement seemed to be the need to reduce crowding.

6a. **How would you or other household members feel about traveling to and from work in a car pool? ("X" ONE ONLY)**

	(159 R)
Very interested	17.6%
Somewhat interested........	21.4
Not at all interested	28.9
Already in car pool.........	4.4
Do not travel to and from work by car..............	27.7

6b. **If it became necessary to restrict the number of cars on expressways and streets in order to reduce pollution and car pools became necessary, how difficult do you think it would be to get into one an existing one or organize one amongst your friends, neighbors and/or work associates. ("X" ONE ONLY)**

Extremely difficult	39.0%
Very difficult	13.9
Somewhat difficult..........	27.2
Somewhat easy.............	10.6
Very easy	4.6
Extremely easy	0.7
Already in car pool.........	4.0

7. One of the major causes of areas of high pollution is traffic congestion. Pollution could be reduced if traffic congestion and stop-and-go traffic was reduced. Listed below are several ideas for reducing traffic congestion. Please tell me how effective you think each of these ideas would be in reducing congestion and pollution. ("X" ONE BOX FOR EACH IDEA)

+2 +1 0 0 -1

Idea:	Very Effective	Somewhat Effective	Not Effective At All	Would Increase Congestion
a. Prohibit parking, loading and unloading on busy streets	61.0	29.2	8.5	1.3
b. Increase the number of one-way streets	24.8	46.4	25.5	3.3
c. Establish reversible lanes on busy streets to be used during rush hours	32.9	38.8.	16.5	11.8
d. Prohibit turns at busy intersections during rush hours	44.0	36.7	11.3	8.0
e. Widen major streets	45.4	35.5	11.9	7.2
f. Widen major streets at intersections only	16.8	46.3	23.5	13.4
g. Provide pedestrian underpasses and/or overpasses	53.2	32.5	13.0	1.3
h. Improve timing of traffic signals	55.6	30.5	12.6	1.3
i. Increase the number and frequency of radio traffic reports	23.0	45.9	29.7	1.4
j. Turn some existing lanes into "bus only" and "car pool only" lanes on expressways and busy streets	41.3	39.4	16.7	2.6

Your ideas (Please List):

(See attached)

▲ - Indicates the weighted mean for each answer.

7. Among the many ideas suggested several patterns developed. The most frequent ideas tended to fall under one of the three following categories:

1. Control of traffic flow (active or passive).
2. A limitation on vehicle freedom.
3. Improvements needed,
   (e. g. mass transportation and technological)

The order of these three categories also reflects the magnitude of responses for each idea.

Under control of traffic much emphasis was on forms of active control e. g. police enforcement of laws and direction of traffic, versus more passive controls such as left turn lanes, staggered lights , and through traffic lanes. Only a couple of respondents considered economic controls on traffic, such as higher tolls.

The need for improvements in mass transportation e. g. more frequent service, cheaper, etc. , and a secondary interest in technological improvements dominated the improvements category.

8. Since traffic congestion is most severe at times when people are going to or coming from work, one alternative for reducing congestion would be to have people start and stop work at different times of the day. That is, some people would start work at 5:00 AM and quit at 2:00 PM, others would work from 7:00 AM to 4:00 PM, others from 10:00 AM to 7:00 PM, etc. How do you feel about this idea? ("X" ONE ONLY)

Very much in favor.........	43.7%
Somewhat in favor..........	26.6
Indifferent	10.1
Somewhat opposed..........	10.1
Very much opposed.........	9.5

9a. Please record the model year of each car owned in your household. (WRITE IN BELOW UNDER 9a)

9b. Please estimate the number of miles each car was driven in the last year. (WRITE IN NUMBER OF MILES UNDER 9b BELOW)

9c. For each car, please estimate what percentage of last year's mileage was accounted for by driving outside your local metropolitan area. (For example, vacation, business trips, short weekend trips, etc.) (WRITE IN BELOW UNDER 9c)

	9a. Model Year	9b. Last Year's Mileage	9c. Percentage of Mileage Outside Local Area
Car #1 (126 R)	1969	12,019	33%
Car #2 (55 R)	1967	9,708	22
Car #3 (7 R)	1970	8,166	38
Car #4 (2 R)	No model (1967 or 1970)	5,750	23

9d. How many licensed drivers are there in your household? (WRITE IN)

Number of Licensed Drivers: 1.75 (157 R)

9e. If better public transportation were available, would you consider disposing of any of the cars you own?

Yes	10.1%
Maybe	10.1
No	79.9

9f. How many? (WRITE IN) 1.05 cars

10a. Overall, how serious a problem do you think auto air pollution is in your city? ("X" ONE BOX UNDER 10a BELOW)

10b. Overall, how serious a problem do you think auto air pollution is nationwide? ("X" ONE BOX UNDER 10b BELOW)

	(160 R) 10a. City	(154 R) 10b. Nationwide
Very serious problem	48.8%	42.9%
Serious problem	26.9	42.2
Slightly serious problem ...	17.4	14.3
No problem at all	6.9	0.6

11. If you have any views or comments regarding any question or idea, please record them:

Central City Comments:

The range of suggestions was quite broad. Two more frequently mentioned topics were mass transportation and the need for technological innovations.

Need for stricter control of vehicles was mentioned particularly with reference to trucks and buses. Some limitation in free access to the city by all vehicles was suggested in several responses. The use of peripheral parking areas being another suggestion.

A note of pessimism regarding future legislation was voiced by several respondents regarding the influence of lobbys and special interest groups.

Suburban Comments:

The respondents from outside the city proper also showed a great concern for limiting pollution. Most favored strict regulation, some suggesting state inspections, large fines, and strong enforcement of existing laws.

Frequently the blame for pollution was passed to other polluters such as trucks, buses, factories suggesting that many respondents don't believe that private autos are a major factor in contributing to the pollution problem. Many seemed to put their faith in the "potential" technological innovations possible in pollution control.

A need for increased efficiency, speed, and personal safety on public transportation was pointed out. The trend of the comments was for stronger enforcement and control of pollution standards and licensing requirements. Lacking from the comments was more than one respondent suggesting that private vehicles freedom of access to the city should be in any way limited.

APPENDIX E

LIST OF CONTROL MEASURES COMPILED BY NEW YORK CITY DEPARTMENT OF AIR RESOURCES

Strategy #1: Vehicle Turnover - Reliance on Federal New Car Emission Standards

Discussion: Federal light duty vehicle emission standards for new cars are becoming increasingly more stringent; by 1975 carbon monoxide and hydrocarbon emission levels are to be reduced by 90% compared with 1970 levels, while by 1976 oxides of nitrogen emissions are to be reduced by 90% from 1971 levels. Thus, the replacement of existing, relatively high-polluting vehicles by newer, lower-polluting vehicles through normal attrition will gradually reduce the average emission rate of the passenger car population.

Goal: Reduce average air pollutant emission rate of vehicle population.

Emissions Reduction Potential: If the emission control systems of vehicles in use are maintained so as to effect continued emission rates within the new car standards, the average carbon monoxide and hydrocarbon emission rates for the passenger car population should decrease yearly about 6.5 percent of uncontrolled (1967) levels, until about 1980. The corresponding nitrogen oxide emission rates should decrease at about half this rate until 1975 and at about 7.5 percent of 1967 rates per year thereafter until 1980.

Projected Impact on Air Quality: In the absence of strategies altering total vehicle miles travelled, average operating speed, and vehicle mode mix, vehicle turnover would produce the following air quality improvements by 1977 (compared with 1970): CO - 40%; HC - 25%; NO_x - 15%

Time to Implement: This turnover is already underway as owners discard old vehicles and purchase newer ones at the rate of approximately 10% per year.

Location Affected: Vehicle turnover will reduce emission rates throughout the metropolitan area of greater importance than the area-wide changes, however, is the impact on New York City's CBD's. There is evidence that present vehicle emission control systems do not work well in driving situations like those in Manhattan. Thus, this strategy may be less effective in the CBD's where ambient levels of vehicle-related pollutants are greatest.

Technical Feasibility: The effectiveness of this strategy depends on maintenance of the emission control systems of vehicles in use. Establishment of annual emissions inspection of registered vehicles would assure continued performance of emission controls. In the absence of such a system the effectiveness of this strategy would be dependent on surveillance programs by EPA. To date they do not have funding or staff adequate for a surveillance program.

Institutional Feasibility: Implementation is dependent only upon Federal EPA enforcing the mandate of the Clean Air Act of 1970 and refusing to grant extensions to the auto manufacturers for compliance with emission standards.

Implementing Agent: United States Environmental Protection Agency.

Legal Authority: Clean Air Act.

Action Required: Provide technical backup to USEPA efforts.

Enforcement: Procedures are prescribed for USEPA in Sections 203, 204, 205, 206, 207 and 208 of the Clean Air Act.

Relationship to Other Strategies: Effectiveness of this strategy will be greatly enhanced by periodic emissions inspections (strategies #3 and #5).

Expected Costs to Implement: No direct costs; indirect costs only to the extent required to provide technical backup to Federal enforcement efforts.

Studies Required: None

Implementation Schedule: None

Strategy #2. Heavy Duty Vehicle Retrofit

Discussion: Regulation of emission levels from new vehicles over 6,000 pounds gross vehicle weight (GVW) has lagged far behind efforts to control light duty vehicle emissions.

The first action to regulate such vehicles was the promulgation on September 8, 1972 of standards for vehicles over 6,000 pounds GVW powered by diesel or gasoline engines. The emission standards apply first to 1974 model year vehicles.

As a result of the absence of emission rate limitations coupled with inefficient operating characteristics these vehicles are a major pollution source in midtown and downtown Manhattan and in the CBD's of the other boroughs. They will constitute an even greater percentage of the pollution problem in future years as light duty vehicles are better controlled. In order to significantly reduce these emissions, retrofitting of emission controls is essential.

Goal: Reduce average emission rate of commercial vehicle population.

Emissions Reduction Potential: It should be possible to reduce emission rates for CO, HC and NO_x from gasoline-powered vehicles by 50% of their present, uncontrolled values.

Projected Impact on Air Quality: The effect on air quality will vary with location in the city. The impact would be greatest in CBD's where truck use is heaviest in particular downtown Manhattan, Bronx and Queens. In such areas projected air quality improvements are: CO - 25%; HC - 20%; NO_x - 5%. Borough-wide projected improvements are: Manhattan: CO - 12%, HC - 10%, NO_x - 2%; Bronx: CO - 5%, HC - 4%, NO_x - 2%; Brooklyn: CO - 7%, HC - 5%, NO_x - 3%; Queens: CO - 8%, HC - 6%, NO_x - 3%; Richmond: CO - 15%, HC - 12%, NO_x - 5%.

Time to Implement: By January 1, 1974, the retrofit device or devices should be selected and implementation can begin. Full implementation should be completed by January, 1975.

Location Affected: The primary impact of this strategy will be felt in the CBD's where motor vehicle pollution is most severe, since these areas are where truck activity is concentrated. (SEE: "Projected Impact")

Technical Feasibility: Since no emission controls have been employed on this class of vehicles to date the potential for emission reduction is great. Development studies must be pursued, however, to demonstrate device effectiveness. The Bureau of Motor Vehicle Pollution Control of the New York City Department of Air Resources is currently engaged in such a study. It appears necessary that a general restriction of lead in gasoline will also be required to minimize deterioration of retrofit devices.

Institutional Feasibility: Any retrofit program is dependent on periodic inspection and maintenance since controls will not generally compensate for engine malfunction. There may be trucking industry opposition to imposition of combined inspection and retrofit requirements. We must also provide a mechanism for retrofitting those trucks not registered in NYC but which do business in NYC. Many such vehicles cross over from New Jersey daily. Suitable arrangements must be made with the State of New Jersey and the Port of New York Authority.

Implementing Agent: The state Departments of Motor Vehicles and Transportation are now responsible for safety inspection of trucks. They would also be responsible for emissions inspection and presumably for retrofit requirements, with technical guidance from the State Department of Environmental Conservation.

Legal Authority: Authority for annual inspection of all vehicles now exists. Legislation is being proposed to amend the State Vehicle and Traffic Law to require more frequent inspections as required by greater mileage accumulation by commercial vehicles. Authority for requiring retrofitting is a separate issue and is also being sought through amendment of the Vehicle and Traffic Law.

Action Required: State legislation must amend law to provide for mandatory retrofitting and more frequent inspection of commercial vehicles. Arrangements must be made with the Port of New York Authority (probably also in the form of legislation) to impose the strategy on vehicles entering the State at NYC river crossings. The NYC Bureau of Motor Vehicle Pollution Control must prove effectiveness of retrofit technology. To insure cooperation of commercial interests a mechanism must be set up in the form of educational programs for fleet owners and mechanics and general public information effort.

Enforcement: Vehicles equipped with retrofit emission controls would be appropriately marked. The New York City Police Department would issue tickets to drivers of trucks not bearing the sticker. Vehicles registered in the city would be denied re-registration without a retrofit sticker. The Port of New York Authority would charge a daily use fee of $25.00 for a vehicle not retrofitted which passes through a tunnel or over a bridge to the city.

Relationship to Other Strategies: Implementation would be greatly facilitated by Strategy #4, Emissions Inspection of Heavy Duty Vehicles.

#2 - 3

Expected Costs to Implement: Direct costs of bookkeeping involved in issuance of stickers: $150,000 per year; enforcement efforts: $100,000 per year; education programs: $100,000 per year; revenue from fines and daily permits: $500,000 per year. Indirect costs include an initial cost of $100 and an annual maintenance cost of $40 per vehicle.

Studies Required: Completion of device evaluation by Bureau of Motor Vehicle Pollution Control.

Implementation Schedule: By July, 1973 have legislation to authorize implementation.
By January, 1974 devices should be evaluated and approved.
By January, 1975 installation should be required and enforcement begun.

Strategy #3: Thrice-yearly Emissions Inspection of All Livery Vehicles

Discussion: All combustion engines and all known emission control devices for these engines require periodic maintenance, and the only way to ensure that it is performed is to inspect the vehicles on a periodic basis. Furthermore, vehicle fuel economy and drivability tend to improve as emission control devices deteriorate and there is a builtin tendency to either allow deterioration to take place or to deliberately disconnect these devices. Therefore periodic inspection is essential to assure continued functioning of control devices.

Efforts to control livery vehicles are particularly important for the Manhattan Midtown CBD where they represent about 70% of annual vehicle miles travelled.

Goal: To insure livery vehicles comply with federal exhaust emission standards.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: After administrative approval inspection facilities can be readied in four months. Effectiveness will be gradual and dependent upon upgrading of mechanics which would require extensive training programs.

Location Affected: Will have its major effect in Midtown Manhattan where taxicab mileage is highest and motor vehicle pollution is very severe.

Technical Feasibility: The Taxi and Limousine Commission in cooperation with the NYC Department of Air Resources, have designed a centralized safety, emission, noise and meter inspection facility with a capacity sufficient for all livery activities. A suitable building has been obtained for the facility (it has been leased by the City with an option to buy) and can be ready for operation within six months of project approval.

Institutional Feasibility: The livery service industry is opposed to outside control and has, so far, been successful in delaying implementation of this program. The recent Board of Estimate decision to reject the current proposal for a central inspection facility (the least costly design) is one indication of the problems to be faced in implementing this control strategy.

Implementing Agent: NYC Taxi and Limousine Commission

Legal Authority: Exists

Action Required: Must secure funding. The Taxi and Limousine Commission with the assistance of the Mayor's office will resubmit another proposal to the Board of Estimate and to the City Council for their consideration. The T & LC must prepare a series of designs to show the comparative costs of centralized versus de-centralized facilities and they and the NYC EPA must "sell" this program to those City officials, that have previously opposed such a program. At the same time the City and the State DEC must meet with all livery service interests to discuss the issues. Of particular importance here is the preparation and distribution of a document describing the need for an emissions test facility, the benefits available to the industry and to the City and the projected costs.

Enforcement: Responsibility of the Taxi and Limousine Commission with periodic facility checks by the City's Bureau of Motor Vehicle Pollution Control.

Relationship to Other Strategies: Independent

Expected Cost:

Studies Required:

Implementation Schedule:

Strategy #4: Heavy Duty Vehicle Emission Inspection

Discussion: Engine deterioration results in severe increases in the emission rates of vehicles in use. Periodic emissions inspection identifies those vehicles which need maintenance to minimize emission rates. Inspection standards would be set according to vehicle age and size and would recognize three additional categories.

(a) 1974 and later model vehicles would be inspected to assure continued compliance with federal standards applicable when new and for the "useful life" of the vehicle.

(b) Retrofitted vehicles would be inspected to determine presence of approved control device and compliance with emission standards.

(c) Vehicles for which retrofit was not mandated would have to meet emission standards established as consistent with reasonable maintenance of vehicles in the size, engine type, and age class.

Because the high mileage accumulation typical of commercial vehicles causes an annual emissions contribution out of proportion to their number, emissions inspection should be required twice yearly.

Goal: Insure that the commercial vehicle population complies with Federal emission standards where they exist and with reasonable minimum levels in the absence of applicable Federal regulations.

Emissions Reduction Potential: As a strategy distinct from mandatory retrofitting inspection would reduce the commercial vehicle population average emission rate for CO and HC by 5 to 10% from present levels.

Projected Impact on Air Quality: City-wide air quality improvements would be 1 to 2% for CO and HC and CBD improvements up to 5% for CO and somewhat less for HC.

Time to Implement: A year will be required to develop inspection procedures and the legal authority. Construction of facilities and program start-up would require a year. Inspection should begin in January 1975.

Location Affected: Will have maximum effect on the total emission levels and air quality in CBD's throughout the City.

Technical Feasibility: Appropriate test cycles and emission rate standards must be developed, but this will not be a difficult or lengthy process.

Institutional Feasibility: Although this strategy is consistent with present safety inspection policies of the State Departments of Motor Vehicles and Transportation, and the Public Service Commission, there are indications that the state legislature may not adopt the program because of the fiscal situation and possible political opposition. Trucking interests, including not only unions and drivers but also shippers and receivers, may be expected to oppose this legislation.

There is a major institutional loophole in the strategy in that a large number of trucks registered in New Jersey do business in NYC. Present law requires NYS registration for any vehicle which carries goods between two points both in the state, but enforcement is very difficult. This potential loophole can be closed by a sticker system as proposed under strategy #2, Heavy Duty Vehicle Retrofit, or by a reciprocal law in New Jersey.

Implementing Agent: State Department of Motor Vehicles and Public Service Commission.

Legal Authority: Legislation is being sought to expand the present safety inspection requirements to cover emissions and at more frequent (twice-annual) intervals.

Action Required: The State Legislature must amend the Vehicle and Traffic Law and the Public Service Law to require emissions inspections and twice-yearly inspections. A cooperative or reciprocal law must be established in New Jersey. The USEPA must develop emissions test procedures for medium (6000 to 16000 pounds, GVW) and heavy (over 16000 pounds GVW) duty vehicles. The NYC Bureau of Motor Vehicle Pollution Control can provide technical assistance on this matter.

Enforcement: The responsibility belongs to the State Department of Motor Vehicles and the State Public Service Commission through their powers to issue inspection stickers prerequisite to registration.

Relationship to Other Strategies: This strategy would support strategy #2, Heavy Duty Vehicle Retrofit.

Expected Costs to Implement: Direct costs to set up and run an emissions inspection program for heavy duty vehicles registered in NYC are estimated to be: capital construction $1 million; annual operation $500,000.

Indirect costs based on increased maintenance costs to vehicle owners are impossible to calculate and would be at least partially offset by improved operating efficiency of the vehicles.

Studies Required: Test procedure development by federal EPA and by NYC Bureau of Motor Vehicle Pollution Control. Emissions survey to establish standards by state Department of Environmental Conservation by NYC BMVPC.

Implementation Schedule: By July, 1973, legislative authority to conduct emissions inspections twice-yearly, and start of emissions survey of heavy duty vehicles. By January 1974 begin construction of facility, purchase of equipment and hiring of personnel. January 1975 begin inspections.

Strategy #5a: Passenger Vehicle Emission Inspection

Discussion: The use of private passenger vehicles is much lesser than that of commercial vehicles in the congested central business districts where automotive emissions are most significant. The "city-wide" pattern of usage of these vehicles, however, cannot permit these sources to be ignored. Passenger cars should comply with the appropriate Federal new car certification standards. Since these increasingly stringent standards have resulted in more complex control systems, proper maintenance and adjustments are of great importance. An annual emissions inspection is the surest method to assure this maintenance and to avoid excessive emissions.

Goal: Ensure that passenger vehicles comply with Federal emission standards.

Emissions Reduction Potential: If the passenger vehicles are not maintained so as to effect continued emission rates within the new car standards, the anticipated yearly decreases in exhaust emissions resulting from normal vehicle turnover should be expected to be reduced by one-half.

Projected Impact on Air Quality: In the absence of strategies altering total vehicl miles travelled, average operating speed, and vehicle mode mix, and assuming normal vehicle turr over emissions inspection would assure the impact attributed to Strategy #1, vehicle turnover. In the absence of this strategy, those improvements by 1977 would be cut by about half to: CO - 20%, HC - 13%, NO_x - 8%.

Time to Implement: Given approval by the legislature by July, 1973, construction o the system could be completed by July of 1974 and the inspectio system could be fully functioned by January, 1975. However, effectiveness is dependent upon the ability of service industry to respond by training mechanics and technicians. Though this effort already has been started voluntarily by the industry, it will probably take two years to reach full effectiveness.

Location Affected: The impact would be area-wide but would be greatest primarily i non-CBD areas where passenger cars represent a large part of to vehicle miles travelled.

Technical Feasibility: Equipment is readily available and there is enough experier in this field to determine an appropriate quick test procedure. Since emissions testing would be an expensive progra it would be advantageous to establish inspection stations testing could be done on an assembly line basis rather tha by service stations or garages.

Institutional Feasibility: State legislature is apparently opposed for budgeting reasons. The auto clubs may be opposed. The State Departments of Motor Vehicles and Environmental Conservation favor setting up a system.

Implementing Agent: State Department of Motor Vehicles with technical guidance of State Department of Environmental Conservation and New York City of Air Resources.

Legal Authority: Authority for enforcing emissions standards at periodic safety inspection now exists. Authority to establish system of stations on a franchise basis is being sought through amendment of the State Vehicle and Traffic Law.

Action Required: Passage of enabling legislation for franchise operation. Securing of capital to construct system. The Clean Air Act states that Federal support may be provided for up to 2/3's the cost of constructing and operating the system. Pressure should be brought to bear on Congress to authorize expenditure of funds to support the New York State program. This requires State/Federal lobbying by the New York City Division of Air Resources and the New York State Department of Environmental Conservation.

Enforcement: State Department of Motor Vehicles with assistance from New York City Police Department in metropolitan area.

Relationship to Other Strategies: This strategy is important for the effectiveness of Strategy #1, Vehicle Turnover.

Expected Costs to Implement: Direct Costs: It is estimated that 64 testing lanes are needed to test all light duty passenger vehicles in New York City. Capital construction costs would be $8.3 million; annual operating costs would be $4.5 million. The per vehicle inspection cost would be about $3.00.

Indirect Costs: If it is assumed that 475,000 passenger vehicles fail the inspection in 1975 (approx. failure rate 33%) and are repaired at an average cost of $20 per vehicle, the total cost to vehicle owners would be $9.5 million. Some of this expenditure would be offset by improved operating efficiency.

Studies Required: Establishment of vehicle population emissions baseline upon which standards for older vehicles will be based (1972 and later model vehicles are warranted to meet federal standards).

Implementation Schedule: By July, 1973 passage of legislation for franchise operation. By January, 1974 begin construction. January, 1975 begin emissions inspection prerequisite to re-registration.

Strategy 5b: Mechanic Training

Discussion: All strategies aimed at control of vehicle emission rates are dependent on the capability of the automotive service industry to provide necessary maintenance of the vehicle populations affected. The industry is presently overloaded and mechanics generally do not know how and are not motivated to repair or tune engines for emissions reduction. It is thus essential that special programs be undertaken to train and motivate the service industry.

Goal: To achieve minimum emission rates from vehicles in use.

Emission Reduction Potential: Without adequate mechanic training none of the other vehicle emission control strategies will achieve their projected emissions reductions. Thus, without this strategy the reductions from these other strategies will be about one-half that given.

Projected Impact on Air Quality: Similarly, without mechanic training, air quality improvements of the other strategies will be cut to about one-half.

Time to Implement: Preparation of training materials and programs will require six months. Training can then begin immediately and the present mechanic population can be exposed to the program to a greater or lesser extent within two years. Thereafter this will become a regular part of the mechanic's training.

Location Affected: Entire area.

Technical Feasibility: Development of optimum teaching techniques will require some experience.

Institutional Feasibility: There may be some opposition from older mechanics who are required to undergo training or who may be displaced by others trained in school.

Implementing Agent: New York City Division of Air Resources and New York State Department of Environmental Conservation.

Legal Authority: None required unless certification of mechanics is instituted. This possibility is being investigated.

Action Required: Preparation of text and film materials, hiring of instructors, and scheduling of training programs.

Enforcement: The market place will enforce this strategy as vehicle owners, forced to meet emission standards, seek mechanics trained (and possibly certified) for emission system repairs.

Relationship to Other Strategies: This strategy is crucial for the success of all the other vehicle emission control strategies.

Expected Costs to Implement: Direct costs for materials $100,000 initially; for instructors $100,000 per year.

Studies Required: None

Implementation Schedule: Prepare materials and hire and train instructors by July, 1973; July, 1973, begin retraining and training programs; January, 1975 phase-out retraining.

Strategy 5c: Diesel Bus Maintenance and Inspection

Discussion: Improperly maintained diesel buses emit significant amounts of smoke and foul smelling gases. In fact, the great majority of citizen complaints about mobile source emissions concern buses. The most effective means of reducing smoke and oder from these vehicles is an effective maintenance program enforced through mandatory inspections.

Goal: Reduce smoke and odor from diesel buses.

Emission Reduction Potential: Noxious smoke and odors from diesel buses can be largely eliminated by a program of effective maintenance.

Projected Impact on Air Quality: Minimal on an areawide basis but very substantial in terms of perceived improvement.

Time to Implement: Improved maintenance can be initiated immediately; inspection procedures will not be available until 1974.

Location Affected: Will affect all areas of the city which are people-congested because it is here that bus use is most dense.

Technical Feasibility: With proper training of fleet mechanics, proper repair and adjustment should be routine.

Institutional Feasibility: No difficulty. MTA presently has authority.

Implementing Agent: Metropolitan Transportation Authority.

Legal Authority: MTA has the authority.

Action Required: Convince MTA to adopt such a program.

Enforcement: MTA

Relationship to Other Strategies: Independent.

Strategy #6 - Strict enforcement of existing traffic regulations

Discussion: Many laws now exist which would, if properly enforced, would reduce congestion. Also, there are regulations authorizing bus priorities on certain avenues in Manhattan. These laws include prohibition of taxi cruising, entering full intersections, making forbidden turns, etc.

Goal: To insure that existing traffic regulations are enforced, in order to ease the flow of traffic.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Immediately for moving violations. Intersection and parking control requires additional staff, which could probably be deployed within 6 months.

Location Affected: Moving Violations: whole city. Parking Violations and Intersection Control: at first, congested CBD areas in all five boroughs, then the whole city if required.

Technical Feasibility: No problems.

Institutional Feasibility: Would require more traffic manpower. Creation of a paraprofessional traffic enforcement group would virtually be a necessity, since street crime is the current focus of police work.

Implementing Agent: Police Department, with support from the Mayor. N.Y.C. Traffic Department should be included.

Legal Authority: Since statutes are existing, new authority is not required.

Action Required: Contact must be made with the Department of Traffic and the Police Department, in order to set up enforcement implementation schedule.

Enforcement: Police superiors must take responsible charge of their men and paraprofessionals, if any. NYS D.E.C. and NYC D.A.R. will make periodic checks.

Relationship to Other Strategies:

7. Banning all Cars in CBD
8. Parking Reduction
9. Through-Movement Streets
10. Exclusive Bus Lanes
11. Regulating Vehicle Mix
12. Motor Vehicle User Fees
23. Consolidation
25. After-Hours Goods Delivery

Strategy #6 - continued

Expected Costs to Implement:
Direct Costs:

Indirect Costs:

Studies Required: None

Implementation Schedule:

Strategy #7 - Banning of private automobiles from the central business districts of Manhattan during the work day.

Discussion: There can be no talk of genuine environmental concern without introducing this most fundamental method of motor vehicle pollution control. Removing the source of emissions and freeing congestion for essential vehicles so that each of them pollutes less is clearly the most fundamental control strategy. The removal of the 15% of the vehicle population comprised of private cars will greatly facilitate flow of more essential vehicles, such as emergency vehicles, buses, and trucks.

Goal: To reduce vehicle congestion in CBD's.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Ninety days' warning should be sufficient. Additional time might be necessary should the opposition seek injunctive relief.

Location Affected: The area of Manhattan south of 61st Street, with the following exceptions: (1) the FDR Drive; (2) the West Side Highway; (3) a well-defined minimum path between the Midtown Tunnel and the FDR Drive, the Lincoln and Holland Tunnels to the West Side Highway, and the 59th Street Bridge to the FDR Drive.

Technical Feasibility: Initially large congestion, especially around Manhattan Island, is expected. It is also expected that sufficient trip diminution will occur so that congestion will not remain unbearable for long. It is felt that traffic patterns will readjust to minimize stress, and that traffic will therefore proceed in an orderly fashion to avoid Manhattan.

Institutional Feasibility: Strong opposition expected from Brooklyn and Queens Borough Presidents, American Automobile Association (Auto. Club of N.Y.), and operators of gasoline stations and parking garages in Manhattan. Demonstration of advantages may assuage Boro Presidents; documentation of costs of autos to non-drivers will probably be essential to blunt the force of the AAA. Compensation under eminent domain will be required to satisfy businesses dependent

Strategy #7 - continued

Institutional Feasibility: on automobile servicing. Negotiation required for MD's, DPL's, FC's. City vehicles that are not emergency vehicles (fire, police, etc.) would be included in the ban.

Implementing Agent: Mayor's Office and Department of Traffic.

Legal Authority: Exists.

Action Required: Technical committee must be designated from EPA, EDA, TAD (Traffic Dept. and Planning Office), CPC, and Mayor's Office. Committee will prepare implementation work program for submission to Mayor. Committee will also plan alternate routing strategie for cars and devise information dissemination plan for alerting drivers to public transit options. Compensate by instituting additional express bus routes. Prepare rebuttal to opposition; if necessar institute injunctive relief (prior to filing). Majo public information job required.

Enforcement: Department of Traffic.

Relationship to Other Strategies:

#6 Enforcement
#8 Parking Reduction (contingency)
#9 Through-Movement Streets (contingency)
#11 Regulating Vehicle Mix
#12 Motor Vehicle User Fees
#25 After-Hours Goods Delivery (contingency)
#31 University Liaison

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: Demonstration project would be more promising than a study.

Implementation Schedule:

Strategy #8 - Reduction in the number of parking spaces in CBD's, either by fiat or by punitive taxation (example: 100 percent parking tax). Elimination of all on-street parking in CBD during business hours, and incentives to garage operators to abandon existing off-street lots at critical locations. Freeze on granting new permits to operate off-street lots. Concomitant effort to develop city-wide parking policy with approval of all concerned agencies is absolutely essential to success of this control strategy.

Discussion: This strategy is a contingency plan to #7, the banning of all cars from CBD during business hours. However, there is a further disincentive included for non-business hours and weekends: there will be fewer places where one will be able to park his car, since off-street lots will be reduced in number. This will also provide a disincentive to own or use a car in Manhattan. Must be accompanied by peripheral parking facilities at transit interchanges, kiss-ride stations, etc.

Goal: To reduce vehicle congestion in CBD's.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Extensive litigation from garage operators expected; however, other implementation times are minimal. Sixty day warning should be sufficient with good media coverage.

Location Affected: First phase: All CBD's. Second phase: Entire city.

Technical Feasibility: No technical problems. Manhattanites who insist on having cars will have to simply pay higher garage rates, or store them outside of Manhattan where there is more room for their storage and operation.

Institutional Feasibility: AAA and garage operators will probably complain, along with wealthy businessmen. Unless litigation ensues, there will probably be just a lot of hard feeling and little adverse institutional effect. Public transportation will, of course, have to be promoted and improved and perhaps the Transit Authority and the MTA can see here a golden opportunity to "sell" the transit system to the public.

Strategy #8 - continued

Implementing Agents: Consumer Affairs, Dept. of Traffic, Police Dept.

Legal Authority: Dept. of Traffic has authority to control on-street parking. Consumer Affairs Dept. licenses garages. City Planning Commission has power to condemn.

Action Required: TAD and EDA should begin to make liaison with licensing agency for garages (Consumer Affairs), and prepare economic and transportation arguments for minimizing parking (DAR can help on this) TAD, EDA, EPA, CPC, and other interested agencies must get together to decide on a city-wide parking strategy, with all agencies' approval. Requires major selling effort with substantial documentation supporting concept.

Enforcement: Police Dept. and Consumer Affairs.

Relationship to Other Strategies:

7. Banning all cars (contingency)
9. Through movement streets
11. Regulating vehicle mix
12. Motor vehicle user fees
6. Enforcement.
13. East River tolls
22. Staggering hours and days
24. Terminal design
31. University Liaison

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: None

Implementation Schedule:

Strategy #9 - Designation of certain crosstown streets in Manhattan for through movement only.

Discussion: Upgrading certain streets to full-fledged arterials with limited-access seems to be an acceptable alternative to freeways slicing through Midtown. However, this is another contingency plan for banning all cars during business hours. Here, however, Saturday and possible Sunday traffic reductions and improvements could be substantial. Vehicles could not turn off until reaching the river. All parking would be prohibited from these preferred access streets; truck deliveries would be schedulized and minimized, with possible relaxation or restrictions on Sundays.

Goal: To reduce vehicle congestion in CBD's.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Six months lead time probably necessary. Negotiation with goods movers most crucial.

Location Affected: Midtown and Downtown Manhattan.

Technical Feasibility: No technical problems with street design. Truck deliveries could be commuter-schedulized by existing programs (Parcel-Post, United Parcel-type, etc.) or by introducing new programs.

Institutional Feasibility: Appears that if congestion is relieved, vehicle users, including truckers, and pedestrians will accept this strategy. Major stumbling block will be negotiations with consignees, shippers, and truckers, for goods movement access in these streets. Perhaps partial condemnation, or a tax on motor vehicle owners (which favors trucks over cars), might be an acceptable compromise. This strategy will have to handled very delicately with goods handlers. Taxi operators will complain, but there should be no ensuing litigation.

Implementing Agent: Dept. of Traffic

Strategy #9 - continued

Legal Authority: Exists...Dept. of Traffic has jurisdiction over street use.

Action Required: Initial contact with Manuel Carballo and Department of Traffic required. Immediate contact with EDA, truckers, shippers, and consignees also required. United Parcel Service should be contacted for approaches to schedulizing deliveries by all truck operators. A major restructuring of traffic must be preceeded by a new traffic plan describing changes to be implemented, impact of same, etc.

Enforcement: Police Department

Relationship to Other Strategies:

6. Enforcement
7. Banning all cars (contingency)
8. Parking reduction
10. Exclusive bus lanes
11. Regulating vehicle mix
13. East River tolls
22. Staggering hours and days
25. After-hours goods delivery
31. University Liaison

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: Before-and-after travel time and speed study.

Implementation Schedule:

a. Negotiate with other City agencies
b. Solicit citizen support
c. Design alternative traffic plan
d. Implement, etc.

Strategy #10 - Expand use of exclusive bus lanes.

Discussion: The exclusive bus lane concept has proven to be successful on a trial section of the LIE and U.S. I-495 just as it has been successful in other parts of the nation. It is a very practical measure to slow the rate of abandonment of transit by the public, which feels that in this age of affluence, no one should ride the subway more than necessary (example of Queens). The express bus concept may cause a decline in conventional service ridership, but in the end it may keep more people on a public transportation mode. Exclusive bus lanes must be instituted as soon as possible on Queens Blvd., Grand Concourse, Eastern Parkway, Ocean Parkway, Pelham Parkway, etc. for peak-direction buses in one or two lanes of off-peak traffic. LIE exclusive bus lane should be extended to city line. Negotiations with Nassau County and the NY State D.O.T. should be undertaken to extend express bus service (and the exclusive bus lane) to Nassau. All other major limited-access arterials should demonstrate exclusive lane principle for peak traffic hours, especially the Van Wyck Expressway to Kennedy Airport, and the Grand Central Parkway to LaGuardia Airport.

Goal: To reduce use of passenger vehicle in CBD's.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Six months to organize traffic patterns for exclusive lanes; one year to negotiate with Nassau County and a bus operator for Nassau express routes.

Locations Affected: All major arterial streets and express highways.

Technical Feasibility: Lane control hardware and buses exist today. However, city must organize traffic patterns and facilities in Manhattan to accommodate additional buses.

Institutional Feasibility: Plan should have wide popular appeal, especially if travel time is significantly reduced and if park-and-ride service is facilitated. The latter option bears additional study and comment by the Transportation Administration.
The support of the Carey Bus Lines Co. should be solicited on the airport routes. This may be necessary in order to appease the taxi industry.

Implementing Agent: NYC Transportation Administration, MTA, Private Operators of Bus Lines.

Legal Authority: Exists - NYC Board of Franchises regulates operation of buses.

Action Required: Meeting between EPA, Traffic, Highways, and the various express bus operators (Queens Transit, Steinway Transit (same management), Triboro Coach, T.A., etc.). T.A.D. Program must be optimized, traffic plan developed to accept added buses in Manhattan (perhaps added bus terminals must be built), etc.

Enforcement: Dept. of Traffic

Relationship to Other Strategies:

5. Enforcement
9. Through Movement Streets
11. Regulating Vehicle Mix
13. East River Tolls
14. Marketing of Transit
15. Timetable Simplification
16. Free Fare
18. No Commuter Discounts
19. Reciprocal Fare Agreements
20. Integration of Bus and Subway Services
22. Staggering Hours and Days
31. University Liaison

Studies Required: None, but a Before-and-After Ridership Study would produce very useful data.

Implementation Schedule:

Strategy #11 - Regulating Vehicle Mix.

Discussion: The plan here is to separate the passenger stream from the goods stream. This would involve restricting some streets and/or traffic lanes to all but goods movement traffic. Other streets might be closed off to goods movement vehicles for certain parts of the day. In some areas tunneling might be used to bring trucks below street level for unloading. This concept can be expanded to separating out vehicles within the passenger stream itself. Certain streets and/or lanes could be designated for bus use only, or for passenger car use only, for all or part of a day. It is hoped that vehicles that travel in patterns contrary to designated patterns will be discouraged from operation.

Goal: To remove as many vehicles from the streets as possible while expediting the flow of those remaining.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Six months to decide which streets are to be used and to install traffic signs. Injuncitve resistance will increase the time.

Locations Affected: Initially Manhattan South of 61st St., particularly in areas like the Garment District. With further study this can be done in the CBD's of other boroughs.

Technical Feasibility: Initially there will be high levels of congestion on streets near the banned streets. It is expected that sufficient trip diminutio will occur and traffic patterns will readjust to relieve the higher congestion level.

Institutional Feasibility: Depending upon the number of streets with traffic restrictions and the location of these streets there may be varying amounts of opposition from automobile or trucking interests. However if they can be convinc that tradeoffs (e.g. a street closed to trucks will expedite auto flow and a stree closed to autos will expedite truck flow) will ease the congestion situation, support instead of opposition may be obtained fro these groups.

Implementing Agent: N.Y.C. Department of Traffic, TAD.

Legal Authority: Exists.

Action Required: TAD does analysis for selection of streets and lanes and hours of closing; Traffic Department installs signs. In general, a master traffic plan will be required because of the need to intergrate all previous strategies into a single plan.

Enforcement: Department of Traffic, Police Department.

Relationship to Other Strategies:

#6 Enforcement.
#7 Banning all cars.
#8 Parking reduction.
#9 Thru movement streets.
#10 Exclusive bus lanes.
#12 Motor vehicle user fees.
#13 East River tolls.
#14 Marketing of transit.
#16 Free fare.
#22 Staggering hours and days.
#23 Consolidation.
#24 Terminal design, etc.
#25 After-hours goods delivery.
#26 Partial Condemnation.
#27 Use of rail for transporting commodities.
#28 Development of waterfront facilities.
#30 Special truck design for urban service.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: A study will have to be done to determine the streets and/or traffic lanes and their hours of banning certain vehicles. Traffic flow measurements should be taken before and after strategy is implemented.

Implementation Schedule:

Strategy #12 - Motor vehicle user fees: a fee would be charged on all private and commercial vehicles operating in or passing through New York City. All funds would be earmarked for urban public transit.

Discussion: The purpose of this user fee structure would be to reduce the number of non-essential vehicles in the City's CBD's, thereby reducing congestion with its associated air and noise pollution, and provide freedom of movement for those vehicles that must remain in the City. The fee would vary with type of vehicle, vehicle weight, and whether or not vehicle would be able to park in a CBD or just pass through. This measure would help insure that motor vehicles pay a larger share of the costs they inflict upon the City.

Goal: Reduce vehicle congestion, VMT, improve alternative transit modes.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Ninety days notice should be sufficient but extensive litigation from many factions would cause long delays. Construction of additional parking facilities outside CBD's will take several years.

Location Affected: Entire City; all vehicles (in and out of state).

Technical Feasibility: All vehicles would be assigned a numbered color-coded window sticker identifying the type of activity allowed within the City of New York. Peripheral parking facilities with connecting bus service must be provided at key points outside CBD's (e.g. 42nd St. Port Authority parking facility).

Institutional Feasibility: The strong opposition that will come from many factons in the City (e.g. vehicle owners, American Automobile Association, trucking associations, etc) will have to be overcome. The mechanism for fee collection will have to be set-up.

Implementing Agent: NYC Bureau of the Budget, City Council, State Legislature, NY State Dept. of Motor Vehicles.

Legal Authority: Legislation supporting such action must be passed by State Legislature.

Action Required: After public notice of procedure, set up the fee collection apparatus. The NYS Department of Motor Vehicles could collect the fee at yearly vehicle registration. The NYC Bureau of the Budget is currently considering vehicle user fees as a mechanism for generating substantial transit dollars. Report due by end of 1972. Must develop justification to support such action (DAR).

Enforcement: NY State Dept. of Motor Vehicles.

Relationship to Other Strategies:
#6 Enforcement.
#7 Banning all cars.
#8 Parking reduction.
#11 Regulating vehicle mix.
#13 East River tolls.
#18 No commuter discounts.
#22 Staggering hours and days.
#23 Consolidation.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: None.

Implementation Schedule:

Strategy #13 - Imposition of tolls on all East River bridges and Harlem River bridges. Toll would be $1 into city, free away from Manhattan.

Discussion: The Tri-State Regional Planning Commission has discovered that there is significant diversion of tripmaking from tolls bridges to free bridges, as a result of the increase in bridge tolls, in January, 1972. This means more excess vehicle-miles of travel, resulting in higher pollution. Furthermore, there is a further pollution increase due to traffic being diverted in this way from high-quality limited-access arterials to lower quality arterials. Tolls are subject to change for carpools, off-peak use, buses, etc. The exclusive-lane concept for bridge crossings and approach roads might be coordinated with a variable toll system.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: One month lead time, plus time required for construction of bridge plazas (approximately one year).

Location Affected: All East River Bridges and Harlem River bridges.

Technical Feasibility: No technical problems, other than the problem of locating the toll plazas and providing for the additional traffic backlog. (Since only one side is affected traffic tie-up should be minimized). It is anticipated that travel on the newly-tolled bridges will drop substantially from present levels.

Institutional Feasibility: Everybody is opposed to the measure especially the Borough Presidents of Queens and Brooklyn and the Auto Club of New York. However, earmarking the tolls for mass transit to the affected boroughs, emphasizing service improvements, might sweeten the appeal of the project.

Implementing Agent: TAD, MTA.

Legal Authority: Legislation required for some bridges; exists for others.

Action Required: Prepare necessary background materials, supporting documentation, etc., (DAR). TAD must meet with the Borough Presidents of the affected boroughs, and prepare an alternative traffic plan to accommodate any proposed changes in traffic flow patterns. State legislature must act to approve added tolls.

Enforcement: Once established, self-regulating.

Relationship to Other Strategies:

#8 Parking reduction.
#9 Thru Movement streets.
#10 Exclusive bus lanes.
#11 Regulating vehicle mix.
#12 Motor vehicle user fees.
#14 Marketing of transit.
#18 No commuter discounts.
#22 Staggering hours and days.
#31 Univeristy Lisison.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: To measure traffic flow over the bridges before and after imposition of tolls.

Implementation Schedule:

Strategy #14 - Marketing Public Transit System.

Discussion: Promote the marketing of bus, subway, commuter rail, and intercity non-automobile modes. Point up hidden direct costs to vehicle owners, as well as the hassles involved in driving and parking in congested situations. This strategy is in keeping with some old policies of the Transit Authority, e.g. The Subway Sun "newsletter" on old trains announcing special services; running of extra trains to Shea Stadium on game days; former running of extra express trains to Rockaway Beach, etc. Chicago and North Western Railway in Chicago has proven that a commuter-oriented railroad, which provides excellent, reliable service at reasonable prices, can succeed and even make a profit. The goal should not be for transit to make a profit; it should be to maximize acceptability and ridership and divert passengers from motor vehicles.

Goal: To divert passengers from automobiles into public transit.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Immediately.

Location Affected: Entire Tri-State region.

Technical Feasibility: No technical problems.

Institutional Feasibility: Very high, provided that the T.A. is willing to suffer possible losses in the first few years in order to make a larger profit later. The downgrading of public transit has been long-standing, and its image will not be completely repairable overnight. For the subway and other listed transit modes, there should be a willingness on the part of management to offer strong new incentives, such as AMTRAK is trying.

Implementing Agent: TAD, MTA, and private bus operators.

Legal Authority: None required.

Action Required: Contact with Leonard Ingalls of TA and with MTA planners required. EDA and TAD should also be involved in negotiations. Private-citizens groups such as I.P.T. should be invited to participate in designing an advertising strategy, including

Action Required: (con't) preparation of a questionnaire designed to reveal preferences people have for public transportation services. Success will depend on actions taken by MTA to improve existing physical plant instead of more glamorous expansion program. Must insist on such policy changes. Requires support from Governor's Office. Suggest that State DEC begin discussions with Rockefeller/Ronan to secure support.

Enforcement: TAD should monitor policy changes and ridership growth.

Relationship to Other Strategies:

#10. Exclusive bus lanes.
#11. Regulating vehicle mix.
#13. East River tolls.
#15. Timetable Simplification,
#16. Free-fare.
#17. Advance fare payment,
#18. No commuter discounts .
#19. Reciprocal fare agreements,
#20. Integration of bus and subway services.
#21. Transit rehabilitation.
#22. Staggering hours and days.
#31. University Liaison for researc

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: Marketing studies with business schools and advertising agencies would be desirable.

Implementation Schedule:

Strategy #15 - Timetable Simplification

Discussion: Rearrangement of transit timetables for easy remembrance of schedules. Publishing of TA timetables, and making them available instantly to telephone inquirers. (Tie in with marketing effort suggested in #14). According to the evidence presented by the Chicago and North Western Railway, a Chicago commuter railroad, the public is willing to sacrifice some headway benefits for streamlined schedules. For example, if a train leaves every ten minutes at a fixed time, the public might well be more satisfied than if the headways change over a relatively short period of time, say from every eight minutes to every eleven minutes over two hours. Every other major city in America publishes its timetables, either at bus stops or posted with a well-publicized transit information number.

Goal: To improve public transit to attract people out of cars.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: One month preliminary work (writing up timetables for publication, etc.). Ninety days' intensive advertising an information number (which should be separate from main TA business number). Continuous posting of schedules at subway stations and major bus stops, with updating as required.

Location Affected: Entire Tri-State region, especially N.Y.C.

Technical Feasibility: No technical problems.

Institutional Feasibility: Precedent seems to be the only bar to this king of effort, although operating funds are at a deficit. Suggest obtaining a demonstration grant from the UMTA for setting up a model public information program for the nation.

Implementing Agent: MTA and private bus operators.

Legal Authority: None required.

Action Required: TAD should immediately contact the TA and follow up on these recommendations. If the TA reneges, the case should be taken to the public for comment. Contact UMTA to solicit interest in program.

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Implementing Agent: MTA and private bus operators.

Legal Authority: None required.

Action Required: TAD should immediately contact the TA and follow up on these recommendations. If the TA reneges, the case should be taken to the public for comment. Contact UMTA to solicit interest in program.

Enforcement: Bureau of Franchises and TAD should follow up.

Relationship to Other Strategies:

#10. Exclusive bus lanes.	#19. Reciprocal fare agreements.
#14. Marketing of transit.	#20. Integration of bus and subway services.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #16 - Offering a much-reduced or "free" fare on transit modes to be funded by general revenues, a transportation surtax, and/or auto user fees. Lacking a "free" fare, a low transfer cost between existing no-transfer buses and between buses and subways should be instituted.

Discussion: The free-fare argument has been advanced as a better way to raise operating revenues, as well as to improve payment distribution. The rider is not the only benefactor of the transit system, yet by law his fare-box revenue must meet all operating costs. Public transit is of vital importance to the business community, which should help pay transit's bills more directly.

Goal: To increase use of public transit to get people out of the habit of using cars.

Emission Reduction Potential:

Projected Impact on Air Qualtiy:

Time to Implement: Approximately one year of research and negotiations should be sufficient to implement this proposal.

Location Affected: All N.Y.C. transit modes in the five boroughs.

Technical Feasibility: No technical problems. Tax witholdings, if any, will be made according to existing procedures.

Institutional Feasibility: It is obvious that such a measure represents a very radical departure from traditional transit funding practices in New York. Other cities, such as Atlanta, Seattle, and cities in the San Francisco Bay Area, have instituted direct transit taxation, resulting (in the case of Atlanta) in reduction of actual user fares. Commerce, California has a bus service entirely free to the user. Nevertheless, one should expect opposition from businesses (including office buildings and department stores) in the CBD and other locations well-served by public transit. Unions would be concerned about loss of jobs for railroad clerks, etc. A tax-withholding system, while easily possible, of financing transit may spur a "taxpayers' revolt" against paying for a service some may not use. However, such a scheme might also get people to leave their

Institutional Feasibility: (con't) cars on weekends, in order to use a transit system they already have paid for.

Implementing Agent: MTA, State legislature, N.Y.C. Budget Bureau.

Legal Authority:

Action Required: Tri-State Regional Planning Commission, TAD, EDA, Budget, City Planning, and EPA should meet with MTA to discuss feasibility. Free-fare advocates such as Robert Abrams should be called in to discuss implementation and experience of free-fare in other cities. Citizens groups should be contacted for support. The combination of vehicle user fees and a transit tax could easily provide sufficient funds.

Enforcement: MTA

Relationship to Other Strategies:

#10. Exclusive bus lanes.
#11. Regulating vehicle mix.
#14 Marketing of transit.
#17. Advanced fare payment (contingent).
#19. Reciprocal fare agreements (contingent).
#20. Integration of bus and subway services (contingent).
#21. Transit rehabilitation.
#31. University liaison for research.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #17 - Initiation of advance payment of fares not only for commuting services, but for other trips as well. Example: Extension of validity of MTA 10-trip railroad tickets from 30 days to one year, and offering of sales of such tickets by mail.

Discussion: For the T.A. facilities, this would be a contingency plan for #16 (free-fare). There is no reason that prepayment of transit fare is not feasible. People would tend to ride more to get "their money's worth." Perhaps some of the social costs could somehow be reimbursed to the T.A. since added transit ridership would result in freer movement of traffic, the need for less traffic police, etc.

Goal: To get people to use public transit instead of automobiles.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Ninety-day lead time to set up machinery for issuance of "passes" and advance-fare payment receipting.

Location Affected: Entire Tri-State region.

Technical Feasibility: Some additional personnel required for staffing a central receiving and mailing office for passes. Some of these personnel can be diverted from token booths, viz. at some of the busier subway stations in the morning and evening.

Institutional Feasibility: Good probability of implementation if a free-fare idea does not develop first. If fare collection is smoothed out at the operating end, and centralized in the front office, a better passenger inventory control can be kept.

Implementing Agent: MTA

Legal Authority: None required.

Action Required: Specific strategies and reduced-fare pass arrangements must be devised. This should be done in concert with the EDA, HRA, TA, TAD, and citizen rider groups.

Enforcement: Self-enforcing (MTA)

Relationship to Other Strategies:
#14. Marketing of transit.
#16. Free-fare (contingent).
#21. Transit rehabilitation.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: MTA feasibility study will probably be required.

Implementation Schedule:

Strategy #18 - Elimination of commuter discount on Port Authority trans-Hudson facilities. Earmarking of tolls for public transportation service.

Discussion: Commuter discounts encourage use of highway facilities at the time when they are the most congested. The incremental expense to society to accommodate these cars at the peak period is exceptionally high. They should, therefore, pay their own way, and support the public transportation that forestalls the entire collapse of the congested highway network.

Goal: To get people to use public transit instead of automobiles.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Elimination of discounts may be done immediately. Earmarking of tolls will required extensive negotiation with the P.A. and with the governors of two states.

Location Affected: Trans-Hudson river crossings (Outerbridge crossing to George Washington Bridge).

Technical Feasibility: There should be either a reduction in auto traffic, an increase in revenue for public transportation, or both. Thus, the output is better in every way. Certainly no technical problems.

Institutional Feasibility: The Port Authority has been loath to curb usage. However, the discount elimination will be acceptable to the Authority since it is very likely that the effect this will have will be to increase P.A. revenues. The AAA will be opposed, and there may be some diversion of workers from NYC to New Jersey. While this is regrettabl there will much more likely be a diversion of some trips to the improved transit system that will result from the appropriation of earmarked funds, which is certainly desirable. Furthermore, any cars removed from the P.A. facilities in the peak hours will be functionally desirable.

Implementing Agent: P.A.

Legal Authority: Authority rests in the hands of the P.A., to be reviewed by the legislatures of New York and New Jersey.

Action Required: EPA Region II office should approach the Port Authority as soon as possible. The Clean Air Act can be used as a lever in negotiation. Bi-State legislature action required.

Relationship to Other Strategies:

#10. Exclusive bus lanes.
#11. Regulating vehicle mix,
#12. Motor vehicle user fees.
#13. East River tolls.
#14. Marketing of transit.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: None required.

Implementation Schedule:

Strategy #19 - Reciprocal fare agreements between different transit companies and different divisions of the same company. Competing transit should be steamlined and rebundant service eliminated.

Discussion: New York City is one of the few places that does not have a consistent transfer policy. There is no transfer provision between bus and subway, between MaBSTOA buses, or between routes of competing companies. Furthermore, there are no reciprocal fare agreements even among the member operating agencies of the MTA. This lends itself to excessive fare payment and operation of redundant service.

Goal: To improve public transit services to get people to use public transit instead of cars.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Six months lead time would probably be required to implement this plan.

Location Affected: Entire Tri-State region.

Technical Feasibility: No technical problems, although a mechanical means of fare division might have to be devised.

Institutional Feasibility: Although private operators and the member agencies of the MTA have traditionally been in competition, today the situation is such that transit modes must work together if they are not to be outpriced by the automobile. The machinery for coordinating within-MTA fares is available. Highway money will almost certainly have to be diverted to transit if this plan is to succeed. Since most transit trips are round trips in New York, apportionment of revenues should present no problem; they will accrue to the operator of the first transportation vehicle.

Implementing Agent: MTA/Private operators.

Legal Authority:

Action Required: A meeting must be scheduled with all the operators, including all elements of the MTA, by the City TAD. If this plan is deemed feasible, a sample list of reciprocal fare schedules must be prepared immediately by TAD.

Enforcement: Self-regulating/MTA.

Relationship to Other Strategies:

- #10. Exclusive bus lanes.
- #14. Marketing of transit.
- #15. Timetable simplification.
- #16. Free-fare (contingent).
- #20. Integration of bus and subway services.

Expected Cost to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #20 - Integration of bus and subway to form a coordinated grid or circumferential-radial system to improve coverage. Facilitation of trip-making *within* boroughs.

Discussion: Subway and surface lines have been created in a fairly random way, based on the vagaries of the original operating companies. Tirp-making by transit has been directed at radial trips to Manhattan, except for the Brooklyn grid bus system. As the cost of operating a car continues to rise, it is imperative to make intra-borough travel competitive in service with the car.

Goal: To provide improved inter-borough public transit service to get people out of cars.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Long-range planning necessary for a lasting improvement. However; a preliminary overhaul of the transportation system could probably be put into operation within a year.

Location Affected: New York City, especially Queens, S.I., and the Bronx.

Technical Feasibility: No technical problems. Most of the intergration operation involves simple re-routing.

Institutional Feasibility: The City and the MTA both agree that the city's trip-making ought to be more radial in character, in order to enhance the "special" character of the CBD. However, this in no way bears on the fact that people must make a significant number of local trips, which are primarily made presently by automobile. Also, long-distance trips that do not have one end in the CBD are cumbersome and time-consuming Success of this strategy will hinge on whether the City Planning Commission, the MTA, and Tri-State can be taught this basic fact. Furthermore, the loss of local trip-making in the advent of long-distance radial suburban commuting is sapping the taxable strength of the city, since the automobile facilitates abandonment of the city, and in fact makes the suburbs possible.

Implementing Agent: MTA

Legal Authority: MTA with Bureau of Franchises coordinating.

Action Required: TAD and MTA must come up with a coordinated transit plan, in cooperation with Tri-State and the State DOT. What is ultimately required is a total challenge to the existing City-MTA-Tri-State theory of continued super-centralization. The preparation of alternative transportation patterns must be augmented by the preparation of suitable alternative urban land use plans.

Enforcement: None required.

Relationship to Other Strategies:

- #10. Exclusive bus lanes.
- #14. Marketing of transit.
- #15. Timetable simplification.
- #16. Free-fare.
- #19. Reciprocal fare agreements.
- #21. Transit rehabilitation.
- #31. University liaison for research

Expected Cost to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #21 - Rehabilitation of existing transit system, through improved maintenance practices, accent on comfort and service quality, and better schedulization.

Discussion: It is clear that various physical aspects of the transit system are in such condition as to repulse ridership. The condition of many stations is dirty, poorly-lighted, and dingy, and old buses wheeze and pollute heavily. The thrust of this strategy is to direct primary attention toward rehabilitation of the existing plant (coupled with better operating procedure), prior to engaging in new capital construction.

Goal: To make public transit more attractive to get people out of cars.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: This item represents a major policy decision involving a rehabilitation program which will be occurring continuously.

Location Affected: All mass transit systems.

Technical Feasibility: No anticipated technical problems, other than providing necessary manpower and funding.

Institutional Feasibility: It always looks better to a public that is accustomed to mediocre service in the last few years to show them a spanking new system of transit, rather than an old train station which is efficient although "down at the heels." The MTA has sufficient capital money available for necessary rehabilitation, provided that new capital construction is shelved. If necessary, it would be advisable to approach UMTA, saying that rehabilitation should be given the highest priority. Feasibility of this project is not very good unless the priority structure of MTA can be drastically altered.

Implementing Agent: MTA, contingent upon receipt of New York City capital construction funding.

Legal Authority: None required.

Action Required: City governmental agencies involved must prepare a unified position and then approach the MTA from a position of strength. If MTA reneges, UMTA should be approached, as indicated above. At the same time, State DEC should approach Governor's office with same goal.

Enforcement: None required.

Relationship to Other Strategies:
- #14. Marketing of transit.
- #16. Free fare.
- #17. Advanced fare payment
- #20. Integration of bus and subway services.
- #22. Staggering hours and days,

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required: None Required.

Implementation Schedule:

Strategy #22 - Encourage widespread staggering of work hours, for starting work between 8-10 a.m. Current peaking causes congestion, frustration, and pollution from commuting trips. Also emphasize 4-day workweek.

Discussion: Staggering work hours and work days has been a plan propose for ameliorating transportation problems in the rush hours; a pilot program in Lower Manhattan has been successful.

Goal: To reduce peaking problem related to transit system; improved transit environment should attract people out of cars and into system.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Gradual introduction, within a time frame of about six months to a year.

Location Affected: All City CBD's and other places where there is locally-generated rush-hour congestion.

Technical Feasibility: Development of a program would required considerable flexibility and consideration of everyone's needs. A systems analysis would be necessary. Port Authority developed a successful staggered-hours project in lower Manhattan.

Institutional Feasibility: Many companies seem to be amenable to such a change, especially for workers who are lower echelon and who are not in the task of maintaining outside liaison as part of the job. Municipal government must lead off, however, to set example for others.

Implementing Agent: City of NY, private interests

Legal Authority: None required.

Action Required: The Port of New York Authority should be consulted as to the details of its experiment. The Office of Midtown Planning and Development and the Office of Lower Manhattan Development, in cooperation with offices within the E.D.A., would coordinate planning efforts. Policy decision required regarding action by City Administration.

Enforcement: None required.

Relationship to Other Strategies:

- #8. Parking reduction.
- #9. Thru movement streets.
- #10. Exclusive bus lanes.
- #11. Regulating vehicle mix.
- #12. Motor vehicle user fees.
- #13. East River tolls.
- #14. Marketing of transit.
- #21. Transit rehabilitation.
- #25. After-hours goods delivery.
- #31. University liaison for research.

Expected Costs to Implement:

Direct Costs.

Indirect Costs:

Studies Required: Reference should be directed to previous studies made by the Port Authority and the Downtown-Lower Manhattan Association. Many other studies have been done on this topic in other cities.

Implementation Schedule:

Interphase of New York City's Goods Movement Programs and Studies with Goods Movement Control Strategies

Some of the programs and studies listed in the previous table fall specifically into line with goods movement strategies. Others are more general in nature and include aspects of many of the control strategies.

General

1. JFK Land Use Study (TAD, EDA, CPC)
2. Hunts Point Transportation Study (TAD, EDA, CPC)
3. Westside Highway Goods Movement Study (TAD)
4. Garment Center Study (TAD)
5. Midtown Manhattan Study (TAD)
6. American University Study (TAD)
7. Census of Trucking (TAD)
8. Garbage Movements in NYC (proposed study) (CPC)
9. Job Opportunities in the Goods Movement Industry (proposed study) (CPC)
10. Unions and Labor Regulations (proposed study) (CPC)
11. Preliminary Goods Movement Study (EPA)
12. EPA Demonstration Project

Strategy #23 - Consolidation of Trucking Activities

1. MIT Study (TAD)
2. Chelsea Piers Consolidation Facility (EDA)
3. Truck Consolidation Center over 30th St. Rail Yards (in conceptual stage) (EDA)
4. Consolidation Terminals over Selected Rail Yards Study (CPC)
5. Consolidation Terminals (proposed general study) (CPC)

Strategy #24 - Terminal Design, etc.

1. Cargo Security Study (TAD)
2. Security of Goods Movement (proposed study) (CPC)

Strategy #25 - After Hours Delivery to Stores and Office Buildings

No specific studies or programs.

Strategy #26 - Partial Condemnation

1. Docking Facility Requirements under the Zoning Regulations (proposed study) (CPC)

Strategy #27 - Use of Rail for Transporting Commodities

1. Expansion of Brooklyn waterfront rail services (EDA)
2. Study for Industrial Development along route of South Brooklyn RR (EDA)
3. Promotion of LIRR freight activities (EDA)
4. Staten Island Terminal and Industrial Development (EDA)
5. Waste haulage by railroad (EDA)
6. N.Y. Dock Railway - Bush Terminal Connection - Overland Route Study (CPC)

Strategy #28 - Development of Waterfront Facilities

1. Waterborne Goods Movement Study (TAD)
2. Containerport Study (CPC)

Strategy #29 - Interstate Commerce Commission/Public Service Commission

1. Rate Structure Study (proposed) (CPC)

Strategy #30 - Special Truck Design for Urban Service

No specific studies or programs.

Strategy # 31 - University Liaison for Research

Negotiations are presently occuring between TAD, Goods Movement Technical Committee and City University.

Strategy #23 - Consolidation of Trucking Activities

Discussion: On only about one half (54%) of the trips made by an urban truck is cargo carried. Tools or equipment needed to perform a service are carried on 23% of the trips, and the vehicle is empty on the remaining 23%. Thousands of operators are involved, often duplicating services. Seventy percent of all trucks are single operations and less than 10% are in fleets of more than 20 trucks. When so many operators are involved it is difficult if not impossible to regulate them and to attempt to make their movements more efficient. Varying degrees of consolidation could be attempted - e.g. pooled delivery system for just one commodity like bread; consolidation for small geographic area like Co Op City; consolidation of all deliveries for midtown Manhattan. Requires the construction of one or more large freight terminals where goods can be consolidated for delivery by vehicles operating with near capacity loads.

Goal: Improve operating efficiency; reduce vehicle miles traveled.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Time will vary depending on the degree of consolidation sought. A pooled delivery system for bread would probably be the shortest in duration to set up and would take 6 months to a year. A new consolidation terminal for midtown Manhattan would take 5 to 8 years to design, build, and optimize.

Location Affected: At first only specific areas, like CBD's for large groups of commodities. Where only one commodity is involved it might be done on a borough wide basis. Eventually consolidated terminal systems should cover the whole city, perhaps the whole metropolitan area.

Technical Feasibility: There should be little or no technical problems, as technology exists but has not been used to great extent.

Studies Required:

Implementation Schedule:

Strategy #24 - Terminal design and location; material handling; research into and promotion of new material handling techniques, and the use of modern management techniques for more efficient operation. Emphasis would be on efficient intermodal transfer of goods for most efficient routing.

Discussion: Research into these technical aspects of the goods movement problem is needed. It will be the careful design and location of terminals and the use of modern material handling and management techniques that will make efforts like consolidation work. New techniques should be developed. In addition there are some already existing techniques that are excellent (e.g. piggy back, containerization) that should be promoted. While it appears that the use of subways for moving goods on a general city-wide basis is not feasible, it may be possible to use them in special cares - e.g. to move goods from one urban subcenter to another, from one industrial park to another. Therefore in the long range view the creation of satellite goods distribution centers, tied closely with the development of urban subcenters and industrial parks, will be desirable.

Goal: Consolidate trucking activities and improve their efficiency to minimize vehicle miles traveled.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: This is a continuing process of change as new methods are developed.

Location Affected. Entire city, especially CBD's and industrial parks.

Technical Feasibility: Research and development is required, although there is a significant little used technology available.

Institutional Feasibility: Although there are modern methods of handling goods available now, incentives will have to be created to promote their use.

Implementing Agent: TAD, CPC, EDA.

Legal Authority: None required.

Action Required: Contact manufacturers and designers of freight handling facilities and equipment, and outfits like United Parcel Service to become familiar with the technology. Promote its use and further research. TAD should develop an active program in this area. Consultants should be hired to prepare detailed plans.

Enforcement: None required.

Relationship to Other Strategies:

- #8 Parking reduction.
- #11 Regulating vehicle mix.
- #23 Consolidation of trucking activities.
- #25 After hours delivery to stores and offices.
- #26 Partial condemnation.
- #30 Special truck design for urban service.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #25 - After hours delivery to stores and office buildings.

Discussion: After hours delivery would take trucks off the streets during peak congestion hours. Retailers would be required to remain open late one or more nights a week, or night cargo drop facilities (on the idea of night mail drop facilities) could be created so that retailer would not have to remain open.

Goal: Remove trucks from streets during rush hours thereby reducing congestion.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Time will vary depending on success of these new operating procedures. An initial area of the City will have to be selected for a demonstration project to test the feasibility of after-hours delivery. The cooperation of shippers delivering to the area and retailers in the area would have to be obtained. It would take at least six months to get the desired cooperation and get the project started. Should this procedure prove successful it should be extended to the entire City over a period of several years. The construction of night cargo drop facilities could be underway at the same time.

Location Affected: Initially cordon trial area in retail section - of City; eventually whole city.

Technical Feasibility: Night cargo drop facilities are now being used by some supermarkets. The facility is a trailer room, locked from 2 sides, where the trucker opens up one side of the room at night and leaves the trailer for unloading through the other side of the locked room. Research would also be needed to determine the minimum sized container that could feasibly be handled with the least possibility of pilferage.

Institutional Feasibility: Most resistance will come from retailers as they will have to pay for personnel to cover the additional working hours and because of the increased chances of pilferage. Hence the cost to the retailer and to the consumer will increase. However this offset in two ways: 1) if retailers construct night cargo drop facilities the continuing cost of additional personnel would be replaced by the lower initial cost of the facility, and 2) the cost to the shipper of the additional premium for night work paid to the teamsters should be more than offset by the time and fuel savings of operating at other than congestion hours. Little or no resistance will come from the teamsters. The combination of delivering at off peak hours and the construction of night drop facilities could bring significant commodity cost decreases. However previous experience with night deliveries has not been successful, largely because cooperation from retailers and shippers was voluntary. When projects of this nature were started they show initial increased cost which caused some of the "volunteers" to drop out thereby causing further problems. This process would continue until the whole program failed. It appears likely that mandatory participation of retailers and shippers will be required to make the project succeed but it may be impossible to force this participation.

Implementing Agent: TAD, EDA, CPC.

Legal Authority: As mentioned above it may be necessary to get mandatory participation in the project and so legislation to that effect would be required.

Action Required: Select trial area with assistance from retailers and major shippers. Develop demonstration project.

Enforcement: TAD, EDA, Police Dept.

Relationship to Other Strategies:

- #6 Enforcement.
- #7 Banning all cars (contingent).
- #9 Thru movement only.
- #11 Regulating vehicle mix.
- #22 Staggering hours and days.
- #23 Consolidation of trucking activities.
- #24 Terminal design, etc.

Expected Costs to Implement:

Direct Cost:

Indirect Cost:

Studies Required:

Implementation Schedule:

Strategy #26 - Partial condemnation--where buildings do not have internal loading dock facilities the City could condemn the street or below street grade area of the building's first floor in order to construct such facilities.

Discussion: Many warehousing blocks and commercial buildings are ill-equipped to efficiently handle their incoming and outgoing truck traffic and tonnage and so streets often become blocked by trucks parking on the streets to load and unload; and truck drivers spend excessive amounts of time searching for parking. The construction of internal loading dock facilities would get the trucks off the street for loading operations. New buildings are required by zoning regulations to have these facilities.

Goal: To get truck loading operations off the streets thereby reducing congestion.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: It would probably take 6 months before it is decided what buildings would be partially condemned and to serve the condemnation papers. As this procedure will almost definitely be fought in the courts it is impossible to say when the facilities would actually be constructed.

Location Affected: The CBD's of the five boroughs, initially the Garment District and midtown Manhattan.

Technical Feasibility: Many existing buildings are usually deep (approximately 180 ft.) and often have above average ceiling height at grade, so conversion is not physically problematic.

Institutional Feasibility: Feasibility is positive. The New York City Corporation Counsel has found that partial condemnation is legal and constitutional. However, it will probably be fought by building owners.

Implementing Agent: TAD, CPC.

Legal Authority: The City has the authority to condemn part of a building.

Action Required: Once it has been decided what buildings are to be partially condemned, condemnation papers are served by the Dept. of Buildings. It would then be up to the Dept. of Buildings to see that work was done in accordance with the Building Code. This should be done according to a master plan for extension to all CBD's. The Garment Center Study can be used as a pilot project.

Enforcement: None required.

Relationship to Other Strategies:

- #11 Regulating vehicle mix.
- #24 Terminal design, etc.
- #25 After hours delivery to stores and offices.
- #30 Special truck design for urban service.

Expected Costs to Implement:

Direct Cost:

Indirect Cost:

Studies Required:

Implementation Schedule:

Strategy #27 - Use of Rail for Transporting Commodities.

Discussion: While it had been generally recognized that transportation sources were the main contributors of air pollution in the City, it had not been known that trucks themselves are a major source of air pollution. With this knowledge it is necessary to reduce the number of trucks on the streets by improving their operating efficiency and by the increased use of alternate modes of transportation. This inefficient movement of goods has resulted in increase congestion, increased noise and air pollution, increased energy consumption, and higher commodity costs. Replacing 200 trucks by 1 train, on the other hand, would reduce congestion, air and noise pollution, and energy consumption, and with more favorable rate structures would reduce the cost of commodities. This City, and the nation, has seen the opposite trend - the replacement of 1 train by 200 trucks with its negative effects. Much freight that had been travelling by rail previously is now moving by truck with the consequence that there are a number of good rail connections that exist in the New York area that are underused. Railroads are continually abandoning rights-of-way. These present trends are environmentally unsound and have to be reversed.

Goal: Use alternate modes to move goods, where appropriate, thereby getting trucks off the streets.

Emission Reduction Potential:

Projected Impact on Air Qualtiy:

Time to Implement: This is a program of continuing improvements that will take several years.

Location Affected: Entire region.

Technical Feasibility: No technical problems. Marketing and improved inter-modal terminal design (see Strategy #24) will help ensure the success of this strategy.

Institutional Feasibility: Many groups are involved in this strategy- regulatory agencies, railroads, industry, unions, citizens groups, etc. The Interstate Commerce Commission and the Public Service Commission will have to cooperate to make rail rates more favorable (see Strategy #29). Negotiations will have to occur with all railroads serving the Metropolitan Area to prevent any decrease in

Institutional Feasibility: (Con't) rail service and to create new linkages and services (e.g. overland route from rapidly growing Brooklyn waterfront area to railyards in South Brooklyn waterfront area to railyards in South Bronx near Hunts Point market). It will have to be demonstrated to the railroads that these services can pay off. The City, through its various agencies, must work to insure that industry will locate along routes of good rail access. Stiff resistance will come from the Teamster's Union if there is any decrease in trucking jobs. However support should come from rail unions.

Implementing Agent: TAD, EDA.

Legal Authority:

Action Required: The initial step is to set up a liaison with the Long Island Railroad, the Long Island Railroad Freight User's Association, and the Penn Central R.R. with a view towards increasing the scope of the two railroads' services. The Economic Development Administration has already made contact with the LIRR Freight User's Association. Later other interest groups will be contacted. In general it will be necessary to investigate the overall problem, define the issue, and develop a long range strategy for change. This can be pursued through the Goods Movement Technical Committee.

Enforcement: None required.

Relationship to Other Strategies:
#11 Regulating vehicle mix.
#23 Consolidation of trucking activities.
#28 Development of waterfront facilities.
#29 ICC/PSC

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #28 - Development of Waterfront Facilities.

Discussion: Just as the rail network has been under-utilized for freight movement, so has our water system. A revival of waterfront operations, similar to what is being done at the Bklyn, waterfront (e.g. car floating, containerports, dock railway operations), is needed. In addition the location of alternate ports on Long Island for the delivery of goods to that area must be investigated.

Goal: Move goods by modes other than trucks, thereby getting trucks off N.Y.C. streets, reduce congestion, etc.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: This is a program of continuing improvements that will take several years.

Location Affected: Entire region.

Technical Feasibility: Little or no technical problems. A faster type of water vehicle than the barge may be required.

Institutional Feasibility: Like the railroad situation, there are many groups involved here - regulating agencies, industry, unions, shiplines, citizens groups. The primary regulatory agency involved here is the Federal Maritime Administration. FMA can suggest new regulatory approaches and permit greater operating flexibility in the maritime industry which would lead to improved transportation services and reduced shipper costs. Industry groups will have to be convinced of the viability of the waterfront (as in the switch of American President Lines from a New Jersey to Brooklyn facility). Negotiations with unions and shiplines will be needed to make increased waterfront services economically feasible. Furthermore, citizen's group may protest the development of certain facilities (e.g. the Red Hook Containerport)

Implementing Agent: TAD, EDA, PA.

Legal Authority:

Action Required: Initially - to promote the development of the Brooklyn waterfront by working with the various groups involved. Proposals for other areas of the City (e.g. Chelsea Piers, Hunts Point) will be a natural consequence. Work can be done through the Goods Movement Technical Committee.

Enforcement: None required.

Relationship to Other Strategies:

#11 Regulating vehicle mix.
#23 Consolidation of trucking activities.
#27 Use of rail for transporting commodities.
#29 ICC/PSC regulations.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #29 - Contact Interstate Commerce Commission and the Publi Service Commission to make them aware of the Region' goods movement problems, and how it is affected by their regulatory decisions. Restructure rate tariff to encourage environmentally sound goods handling procedures.

Disucssion: The ICC and PSC are responsible for setting rates on trucks and rail shipments and other related items. Their decisions in a number of instances (e.g. permitting the granting of discounts to shippers who will truck goods from New Jersey instead of using rail) have contributed to the goods movement problem.

Goal: Obtain rate structures reflecting socioeconomic and environmental impact of trucking and that will help to foster use of alternative modes for moving goods.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Contact can be made immediately but when concret action by those bodies will occur is unknown.

Location Affected: Entire region; interstate carriers.

Technical Feasibility: No technical problems.

Institutional Feasibility: Because of interest groups representing the various railroads and truckers, decisions favorable to improving the goods movement situation will be difficult to obtain. Truckers will lobby against any rate changes that favor modes other than truck. A railroad will resist any rate change that gives better rate division (i.e., when several railroads have to handle a freight delivery, the rate for the shipment is shared by the railroads involved) to another railroad.

Implementing Agent: Goods Movement Technical Committee.

Legal Authority:

Action Required: Set up meeting with members of ICC and PSC. The Goods Movement Technical Committee must investigate existing rates structures in order to suggest desired changes.

Enforcement: None required.

Relationship to Other Strategies:
#27 Use of rail for transporting commodities.
#28 Development of waterfront facilities.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #30 - Special Truck Design for Urban Service

Discussion: New design of trucks can make it easier and quicker for goods to be delivered. For example, United Parcel Service trucks are specially designed by them for ease in loading and unloading. Since many trucks travel around with an average of only 10% of capacity, it appears that many businesses should be using smaller trucks. Thus vehicle owners must be made to justify the size of their trucks at registration time. This ties in closely with Strategy #12, Motor Vehicle User Fees, where the fee would increase with increased vehicle weight. This kind of fee schedule could encourage the use of smaller sized trucks.

Goal: Optimize vehicle design to insure efficient operation, reduce number of vehicles required, and thereby reduce congestion and VMT.

Emission Reduction Potential:

Projected Impact on Air Qualtiy:

Time to Implement: Once criteria are established for limiting vehicle size, the procedure could probably be started within a year. New design of trucks is a continuing process and has no specific time for implementation.

Location Affected: All trucks operating in New York City.

Technical Feasibility: No technical problems.

Institutional Feasibility: The auto industry will claim that there is no market for a specially designed urban truck and that pursuing such a project would result in increased expenditures for them. However there is good precedent for special trucks - Postal Service, United Parcel Service, and other trucks for specialized industries. Truckers will have to be convince: that the increased cost of a special urba: truck would be more than offset by the savings in time for pickup and deliveries. Having an operator justify the size of

Institutional Feasibility: (Con't)

his truck at registration time will be difficult to implement. Many operators will claim that while they could use a smaller truck 4 days a week, they may have a large shipment on the fifth day, that requires the larger truck, Furthermore, should it be determined that an operator is using too large a truck, it could be a heavy financial burden to force him to get rid of the truck right away. Guidelines would have to be drawn up to determine how soon any operator should be required to remove this truck from the City's streets. Legislation would be needed to permit this registration procedure. It also has to be decided as to what agency will be in charge of this operation as additional staff would be required.

Implementation Agent: Goods Movement Technical Committee.

Legal Authority: Authority to permit registration review procedure.

Action Required: Contact truck manufacturers in Detroit to appraise them of the need and desire for new design in urban trucks. Seek the assistance of industry for ideas on what is most appropriate design. Forward specifications to manufacturers. Contact N.Y.S. Dept. of Motor Vehicles for cooperation in the registration procedure.

Enforcement: None required.

Relationship to Other Strategies:
#1 Vehicle turnover.
#2 Heavy duty vehicle retrofit.
#4 Heavy duty vehicle inspection.
#11 Regulating vehicle mix.
#24 Terminal design, etc.
#26 Partial condemnation.
#31 University liaison.

Expected Costs to Implement:

Direct Costs:

Indirect Costs:

Studies Required:

Implementation Schedule:

Strategy #31 - Establish a liasion with a local university to help spur research in goods movement.

Discussion: Inefficient movement is a large urban problem yet it is poorly understood. Little work on the problem has been done by anybody, including educational institutions. By establishing a relationship with a university we can learn more about the problem and perhaps stimulate work in other universities. The Federal Department of Transportation has established a University Research Program which is designed to increase the contributions of universities to the solutions of National, State, and local transportation problems. DOT has designated a separate fund for giving grants to universities for research under this program. The City University of New York has made contact with the N.Y.C. Transportation Administration to determine what transportation projects TAD would like to see done. Suggestions for projects are being submitted to CUNY through the Goods Movement Technical Committee. A permanent liaison for goods movement at CUNY could be established through this program.

Goal: Introduce goods movement problem to the academic community; solicit assistance in developing suitable control strategies.

Emission Reduction Potential:

Projected Impact on Air Quality:

Time to Implement: Contact with CUNY has already been made and grants requests are now being prepared by them. Research on the goods movement problem will be a continuing process.

Location Affected: Depending on the nature of the research this strategy could have effects on local, state, and national levels.

Technical Feasibility: No technical problems.

Administrative Feasibility: CUNY has expressed interest in persuing the problem. Grants from EPA and DOT will be needed to finance the studies. Under the University Research Program DOT has made available $4 million nationwide for research grants in transportatio...